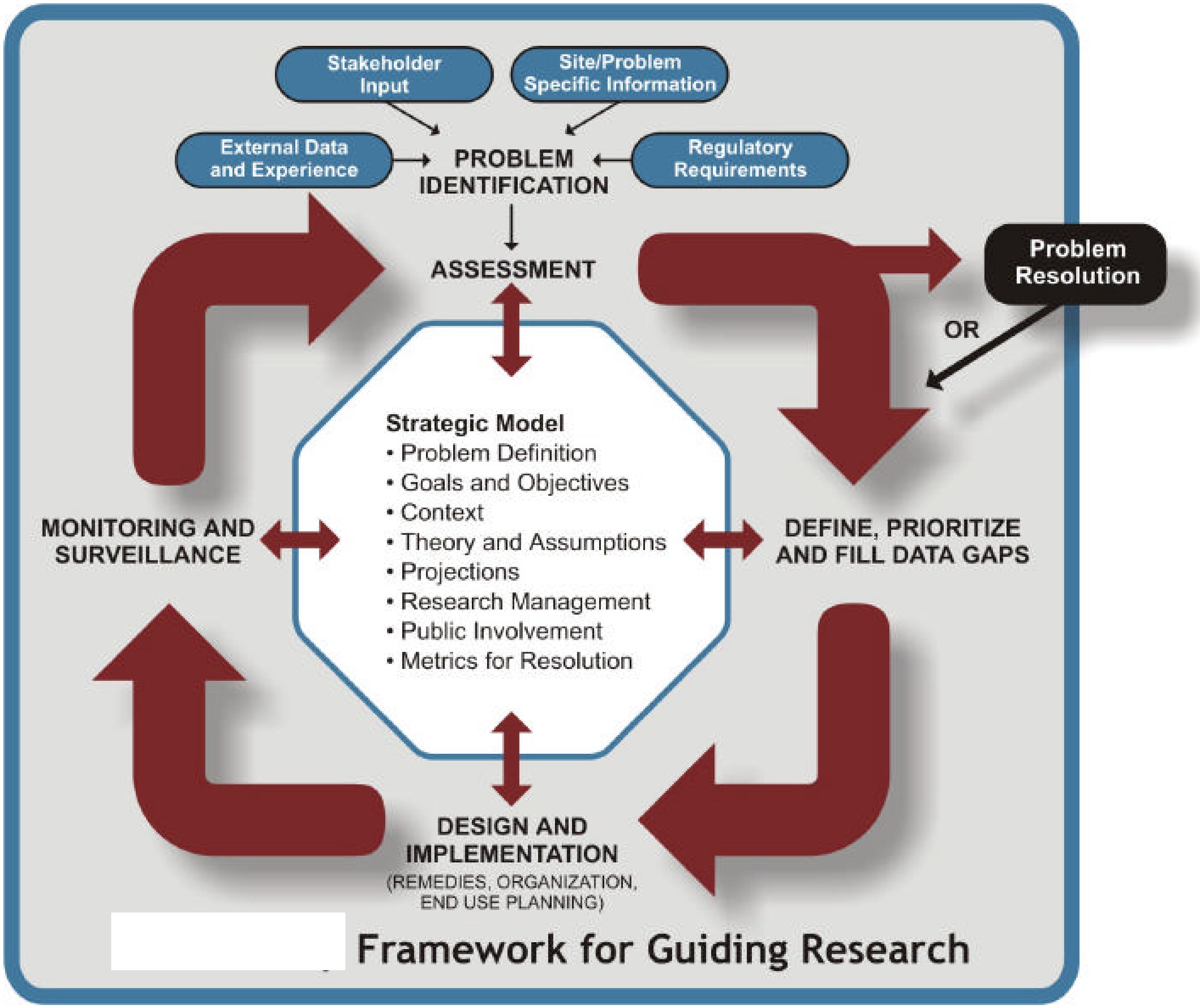
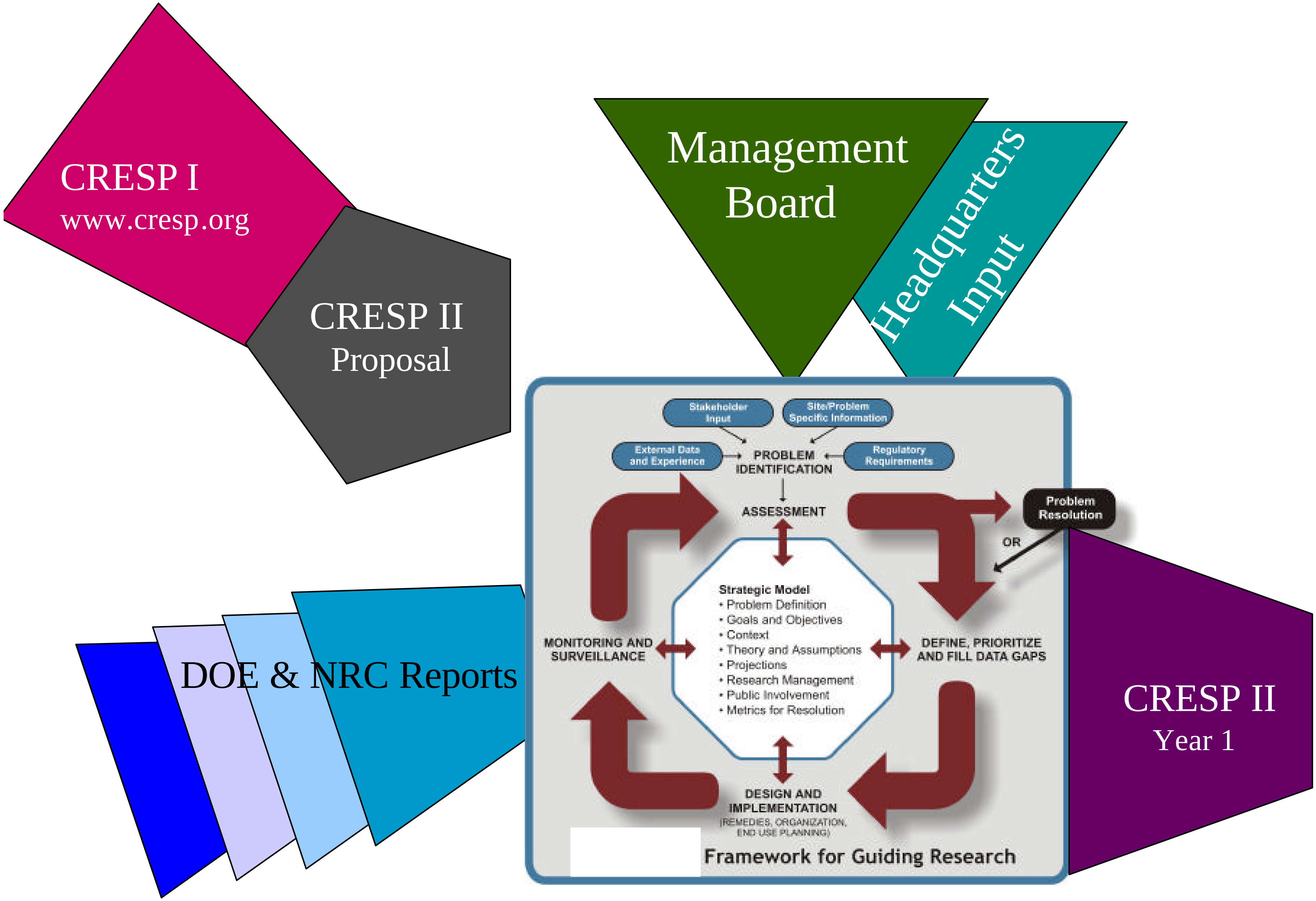
Long-Term Stewardship Methodology Overview

a presentation prepared by
Charles W. Powers, Ph.D. and PI CRESP II
Industry Partnership for Environmental Science and Technology Conference
National Energy Technology Laboratory Conference
Morgantown, West Virginia
October 30, 2001

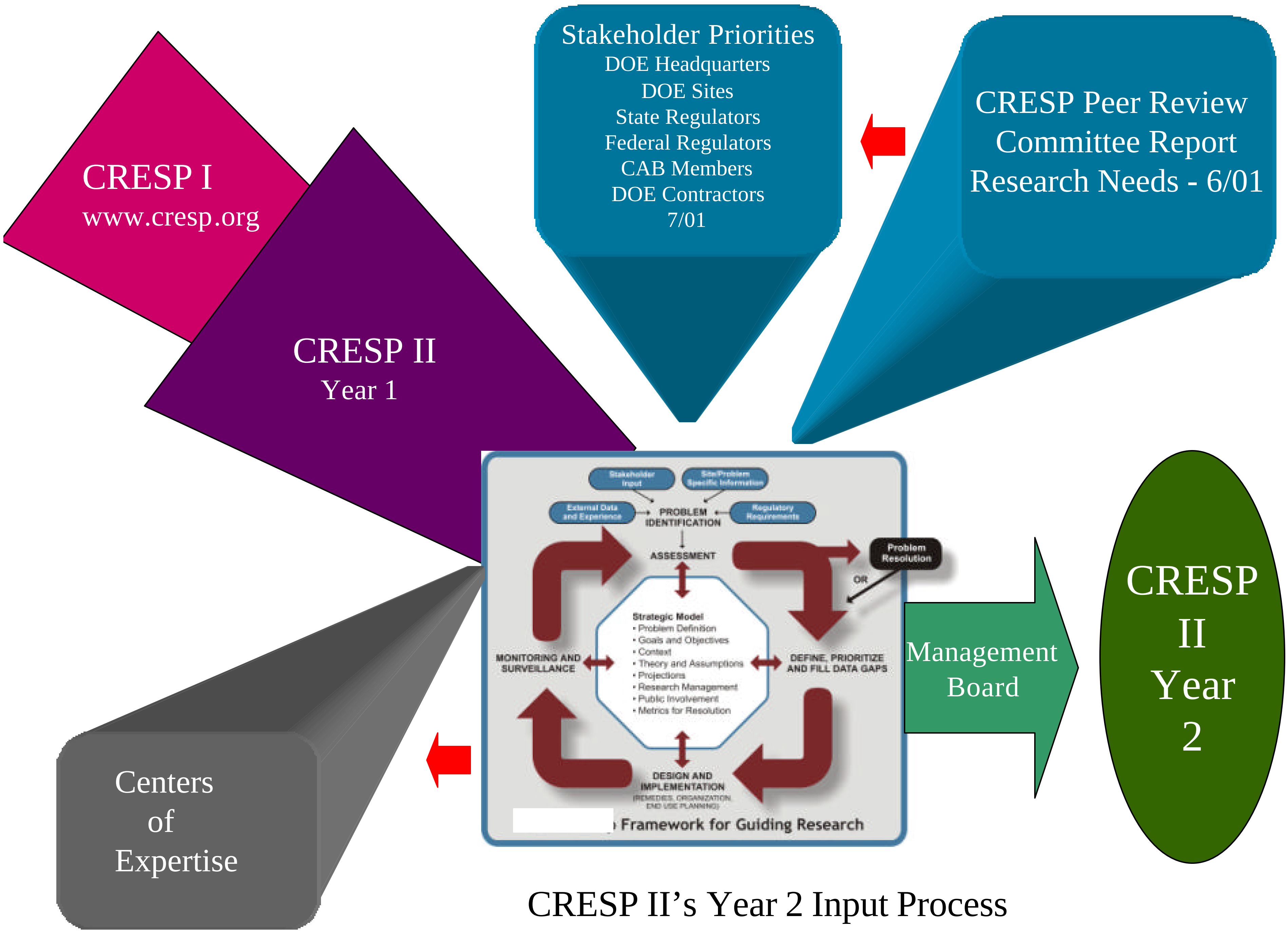
CRESP II

CRESP II’s Fundamental Paradigm





CRESP II's Fundamental Paradigm: ***How it Evolved***



CRESP II’s Year 2 Input Process

Members of the CRESP Peer Review Committee

Ahearne, John F., Ph.D., Director, Sigma Xi Ethics Program
Bingham, Eula, Ph.D., University of Cincinnati
Carter, Melvin W., Ph.D., International Radiation Protection Consultant
Cooper, William, Ph.D., Michigan State University
Fairhurst, Charles, Ph.D., University of Minnesot
Jasanoff, Sheila, Ph.D., Harvard University
Jim, Russell, Yakima Nation
Kimbrough, Renate D., M.D., Toxicology Consultant, Washington, D.C.
Lippmann, Morton, Ph.D., New York University
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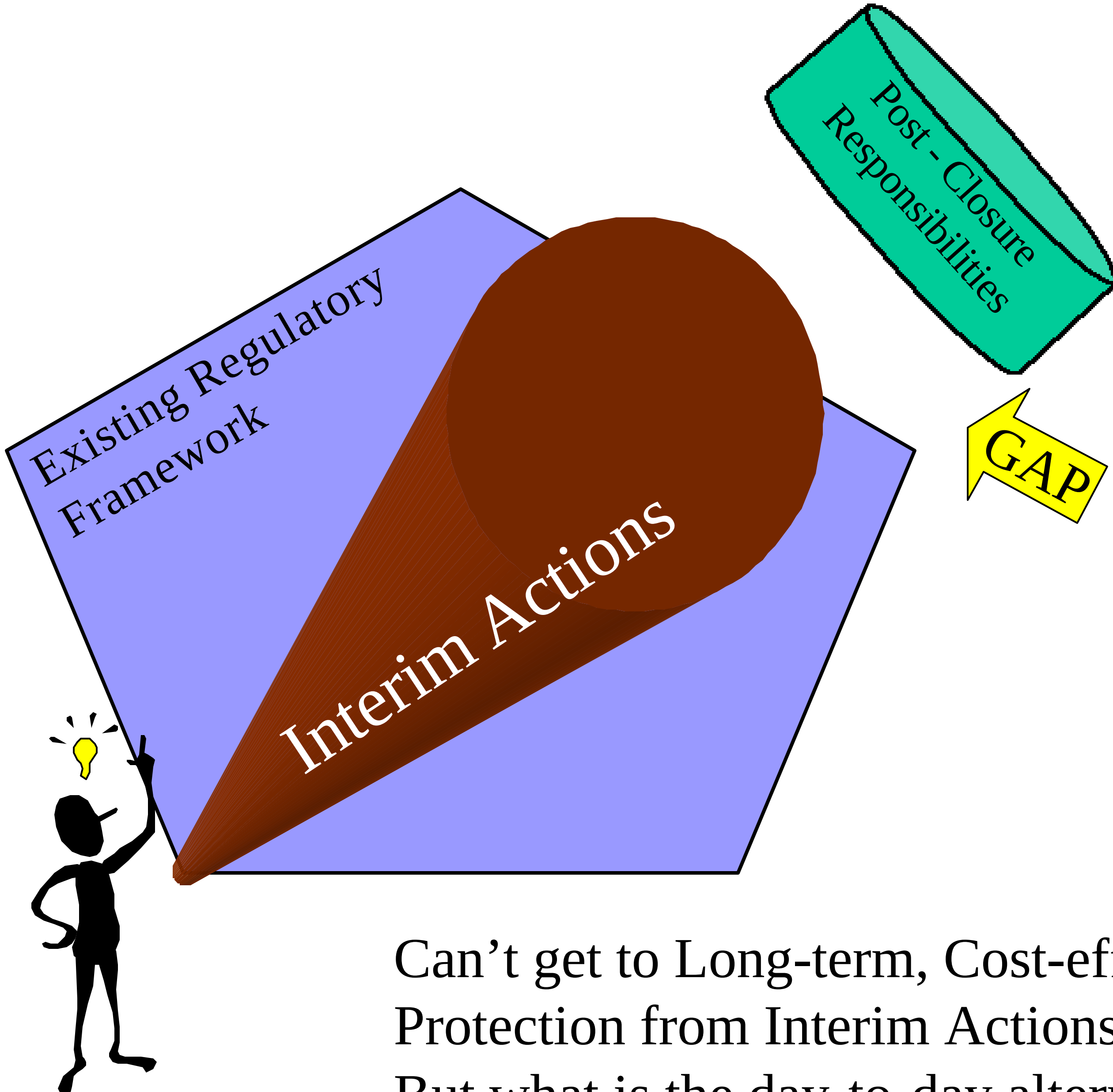
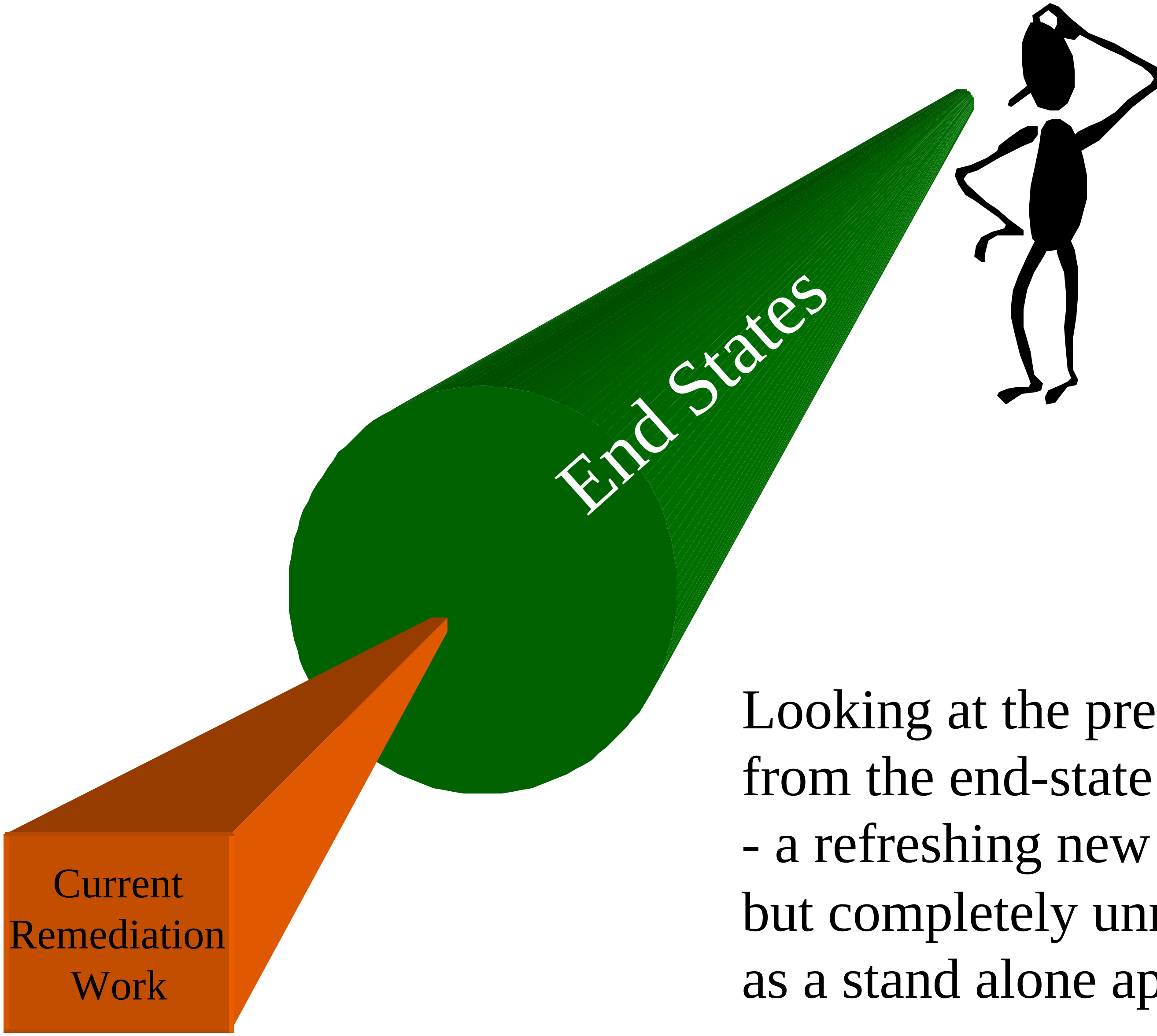
Upton, Arthur C., M.D., UMDNJ-Robert Wood Johnson Medical School[*]
Walker, Bailus Jr., Ph.D., M.P.H., Howard University
Zeise, Lauren, Ph.D., California Environmental Protection Agency
.

[*]Chairman of committee.



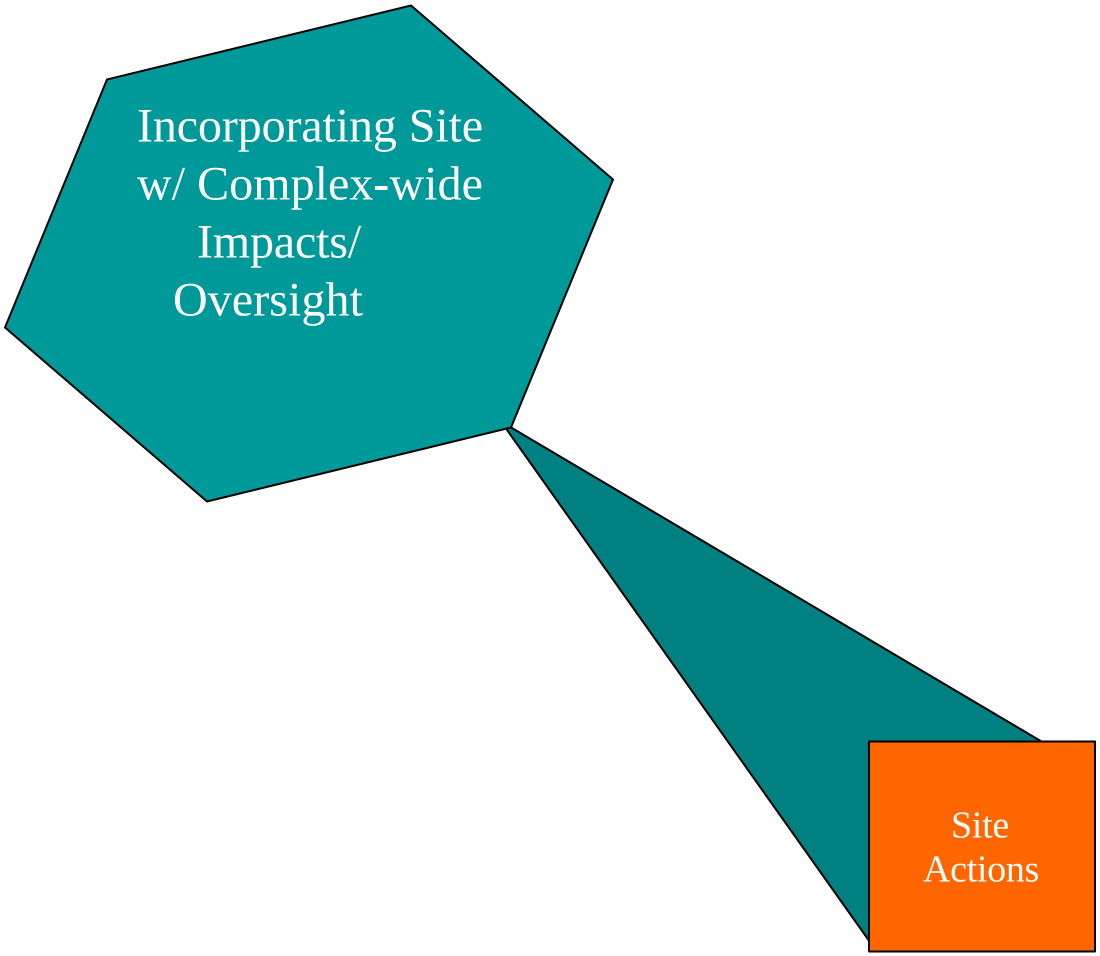
Can’t get to Long-term, Cost-effective
Protection from Interim Actions.
But what is the day-to-day alternative?

Developed by Charles W. Powers



Looking at the present
from the end-state future
- a refreshing new start
but completely unrealistic
as a stand alone approach?

Developed by Charles W. Powers



Fundamental uncertainty about how site-specific cultures and characteristics should shape the balance between national consistency and local decisions

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Because of:

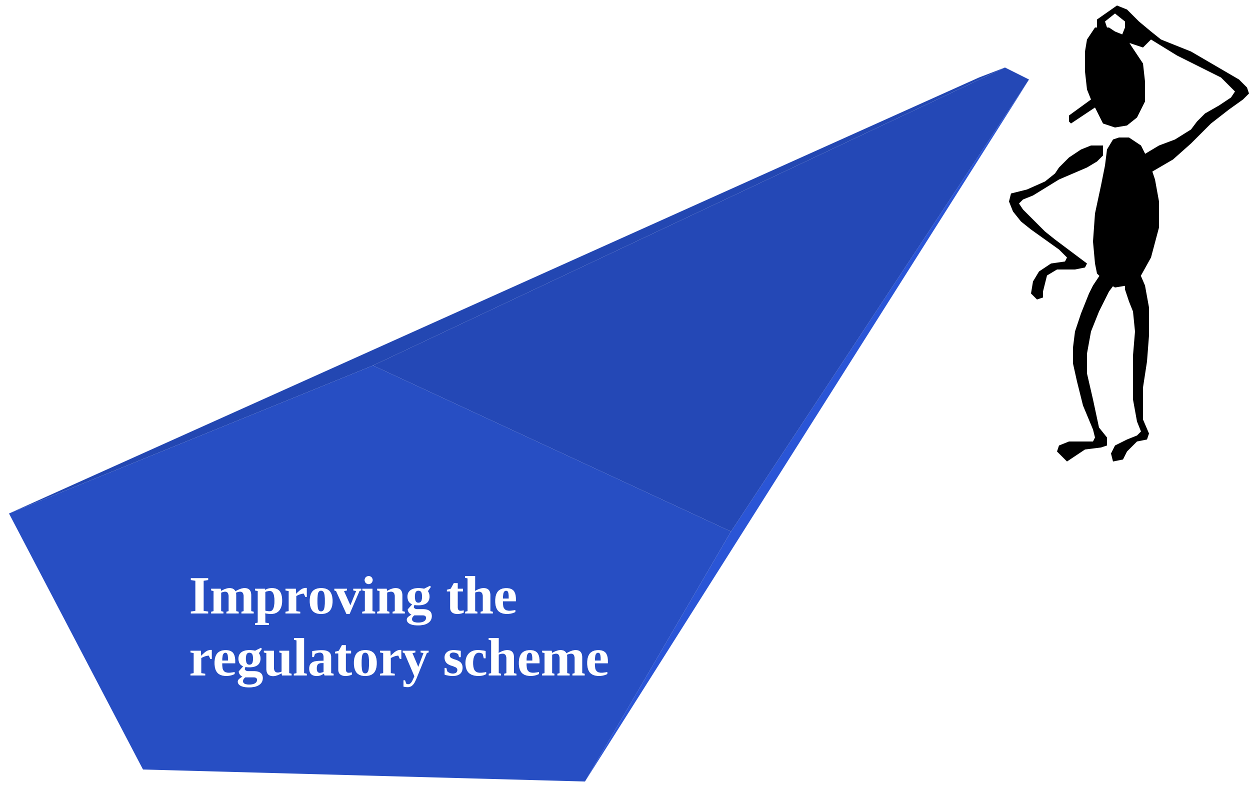
Economics alone?

X Feasibility alone?

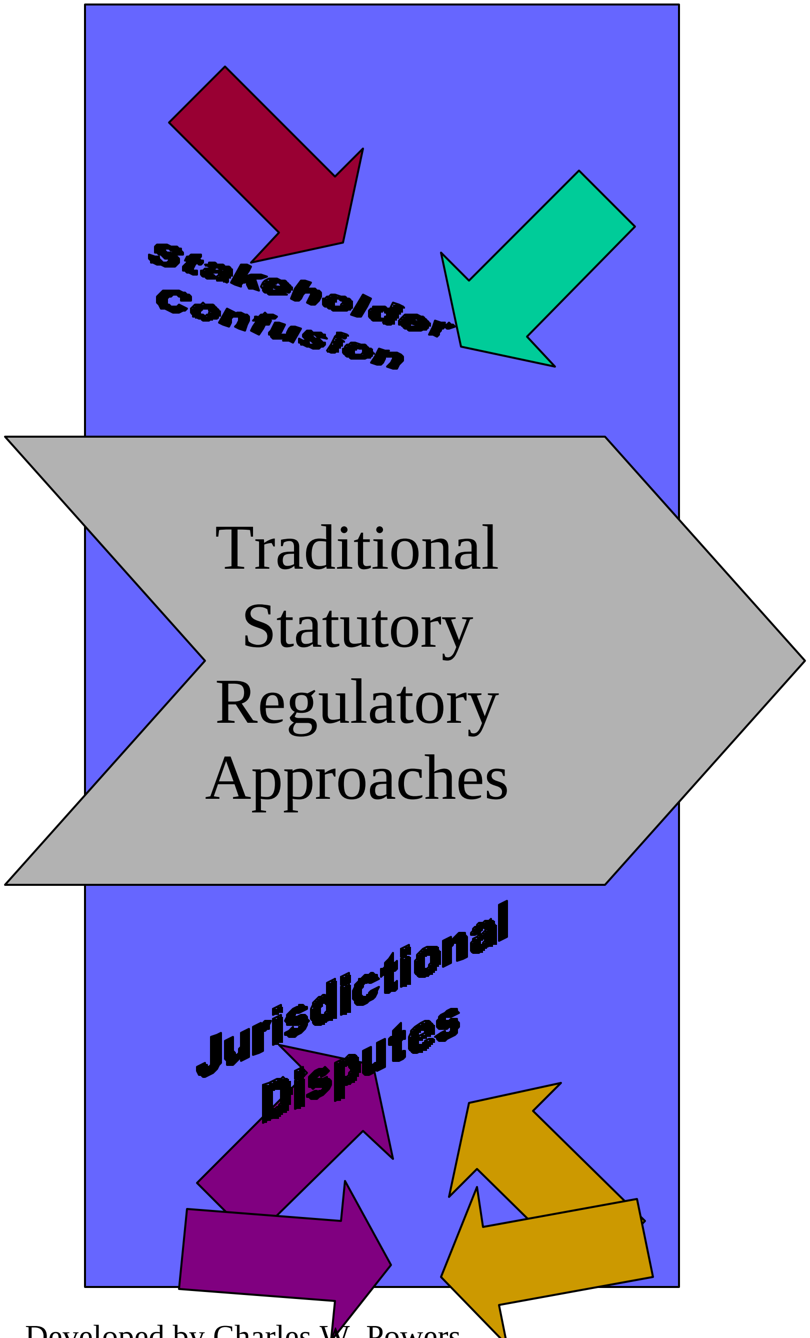
Implementability alone?

Long-term Protectiveness?

All of the above?



The last, best chance for a doable regulatory process?
Only if it is part of a complete picture that acknowledges how little we have characterized and how inadequate the current technology is!



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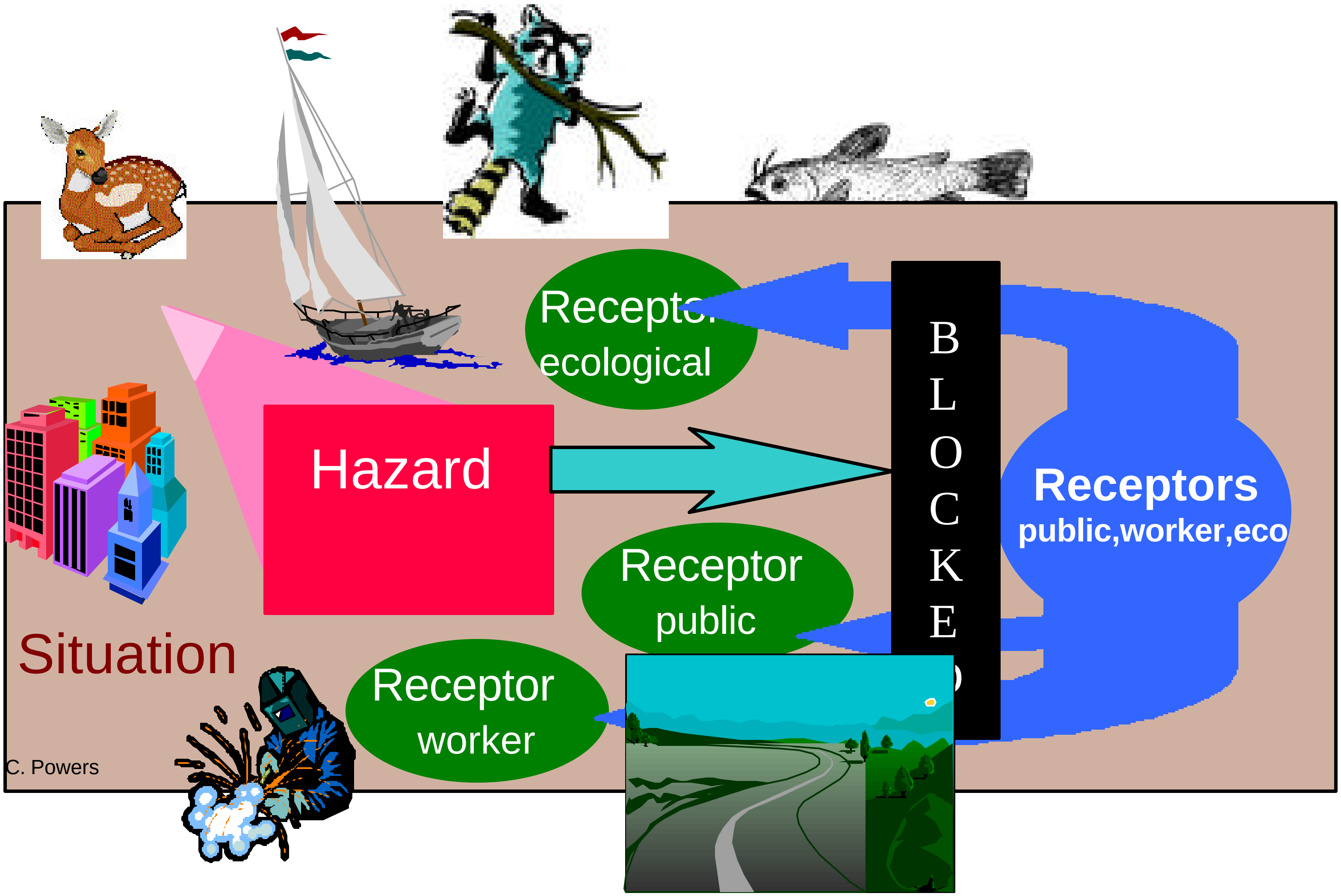
Specific Changes in the Regulations Themselves Needed Especially at DOE

Changes in the Way Regulations Relate or are Implemented Together

Problem-Responsive, Integrated Regulatory Compliance

Application of Approaches Needed at DOE Sites and Already Used Elsewhere

Regulations Fashioned for the Unique Problems of DOE Sites



The challenge of cost-effective, long-term protection should not be made more simple than it really is ----- but on the other hand

Developed by Charles W. Powers

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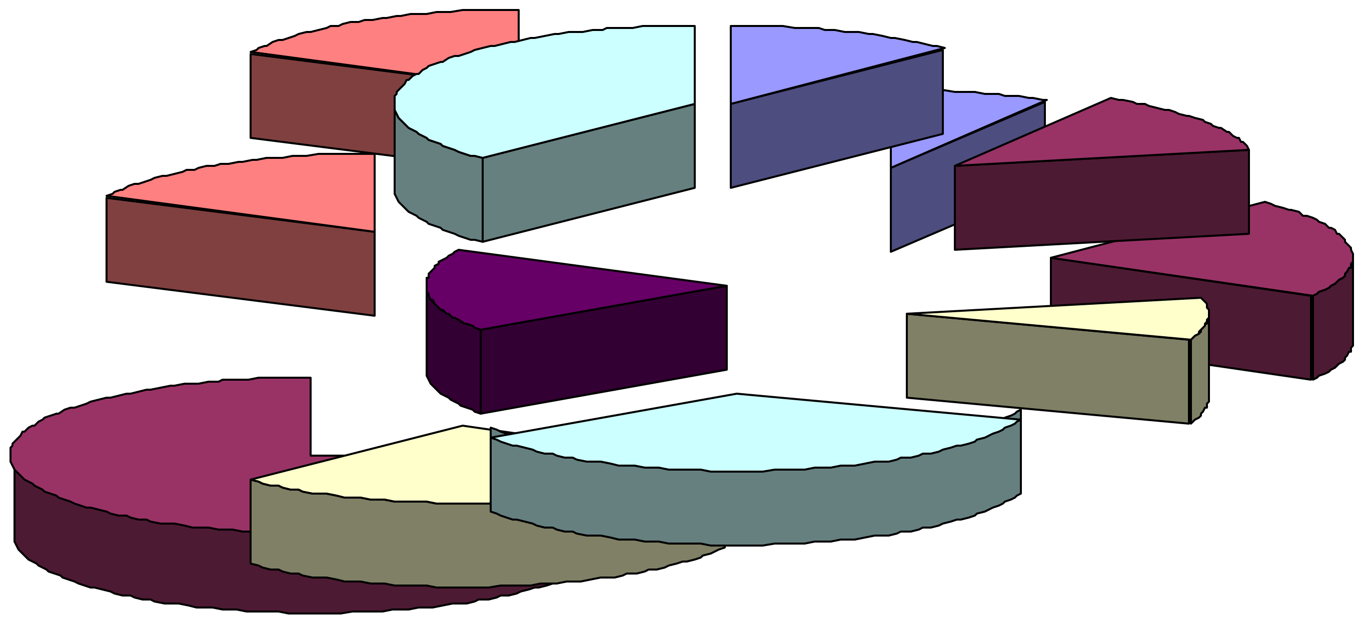
The really major challenge ahead will come in:



Achieving Systems-Like Efficiencies

while Building in Flexibility and Finding Much Simpler Solutions

Strategically Providing for Protective Overlapping

without Unnecessary Redundancy

Relying on Effective Public Communication of Residual Risk

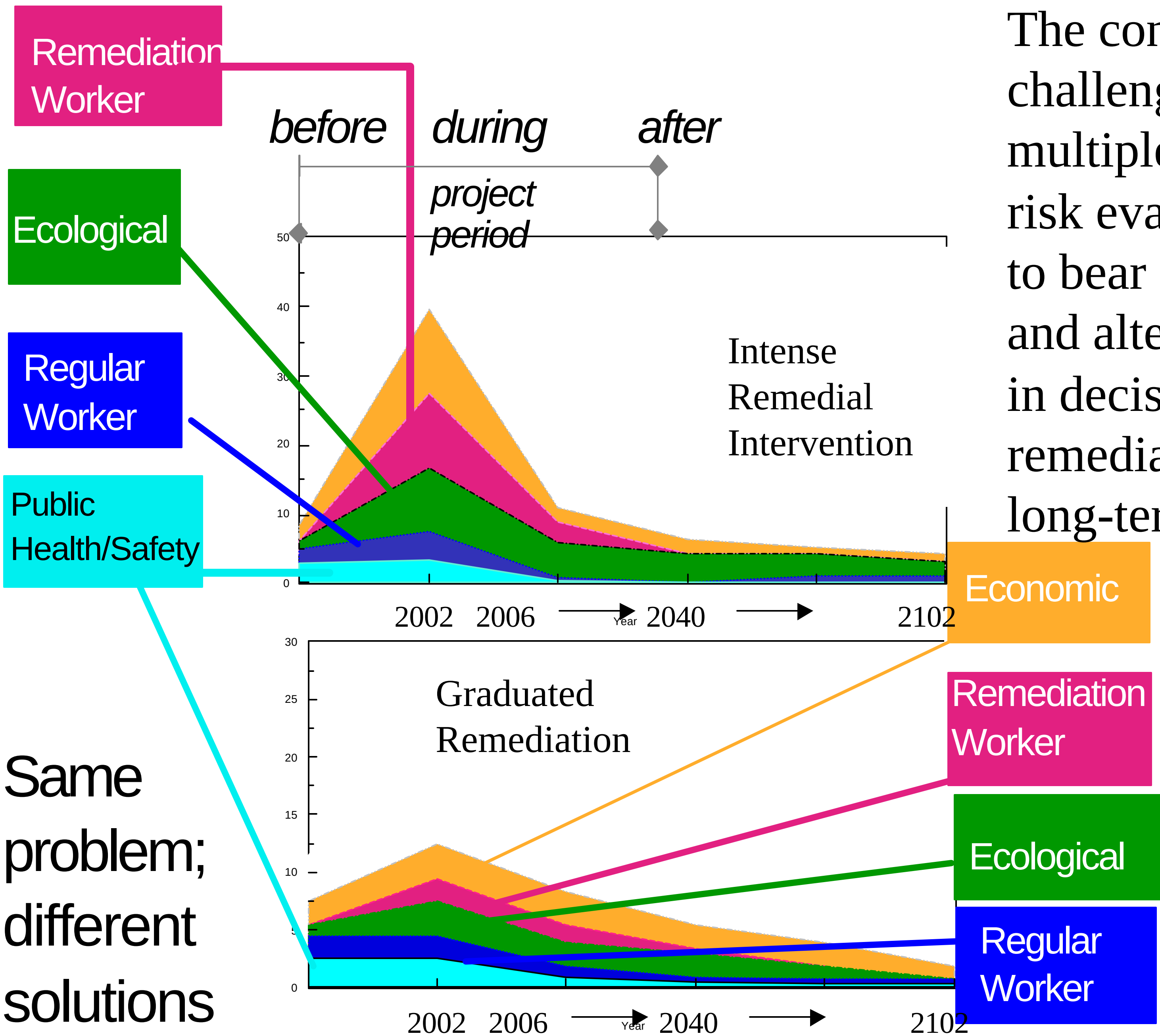
without Sacrificing Safeguards and Security

A Key Hypothesis:
Focused and Credible S&T,
is essential to form the primary
basis for a Regulatory Evolution
that better fits the challenge of
DOE cleanup to the compliance
process:

Why?

EM is Always a
Compliance Program

Natural processes and other less aggressive remediation
Require special justification, time and trust



The continuing challenge to bring multiple types of risk evaluation to bear on the sequence and alternatives used in decisions on remediation and long-term protection

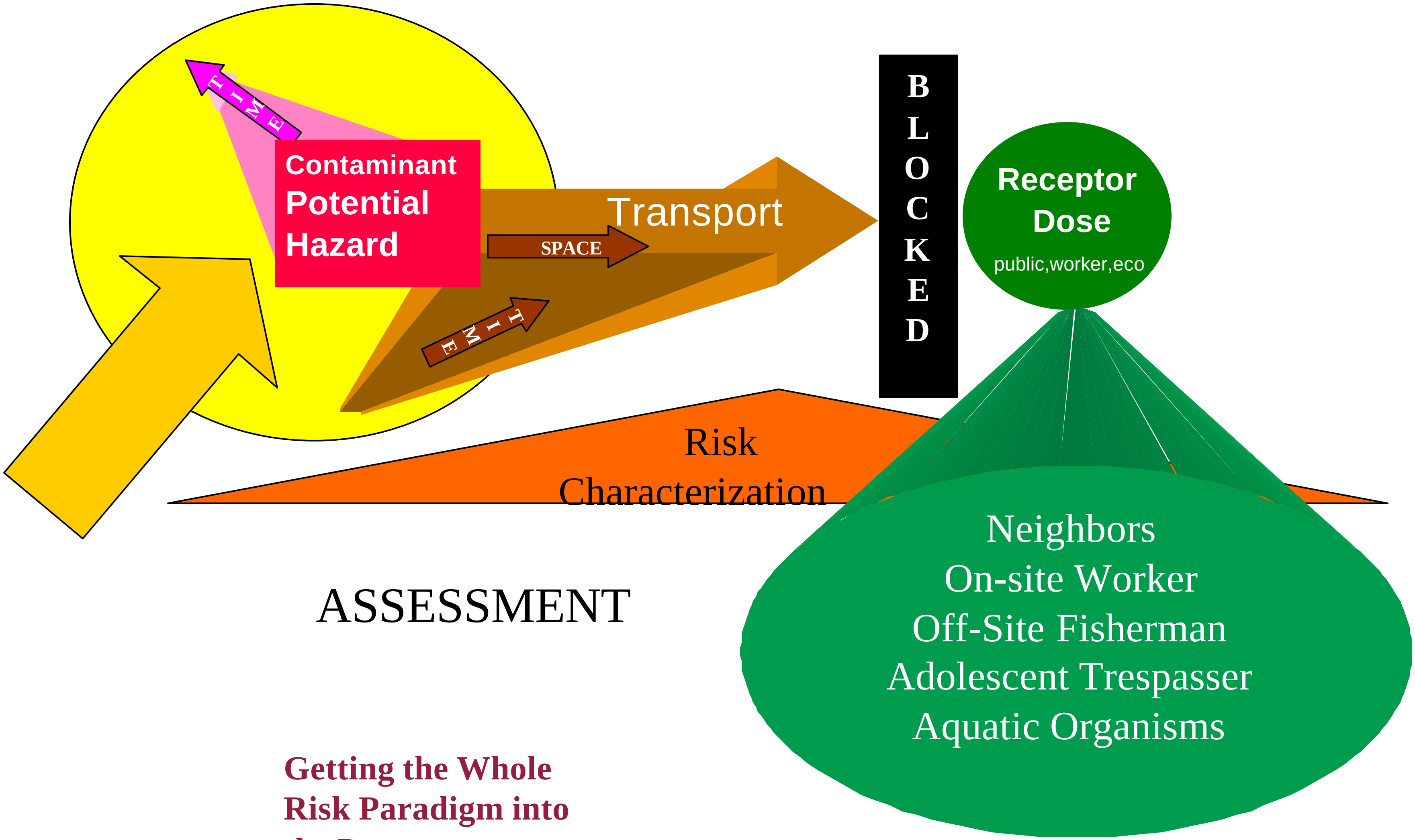
Same problem; different solutions

Developed by Charles W. Powers

All Data Sets are the Product of the Purposes
and the Cultures and the Precise Questions
that they are Answering

In a compliance program, the data - and the S&T
that generates it - are “prisoners” of the specific
culture/requirements that led them to be found
and gathered.

The available data, even if relevant, but must be credibly
reorganized and augmented to create the possibility
of serving in a better regulatory environment



Getting the Whole Risk Paradigm into the Process

Developed by Charles W. Powers

Hazard Management: 3 basic options

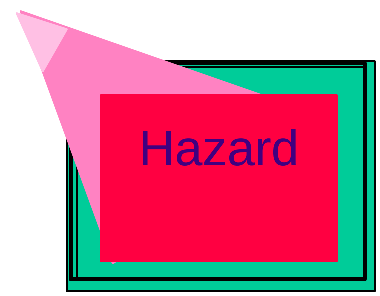
Make it go away:

TREAT TO MAKE LESS HARMFUL
- CHANGE THE PHYSICAL/ CHEMICAL CHARACTERISTICS

OR REDUCE VOLUME OR ATIVITY (e.g.. RADIONUCLIDE HALF-LIVES)

Tie it up so it can't harm:

ENCAPSULATE OR CONCENTRATE/ IMMOBILIZE PERMENANTLY



Tie it up until it goes away

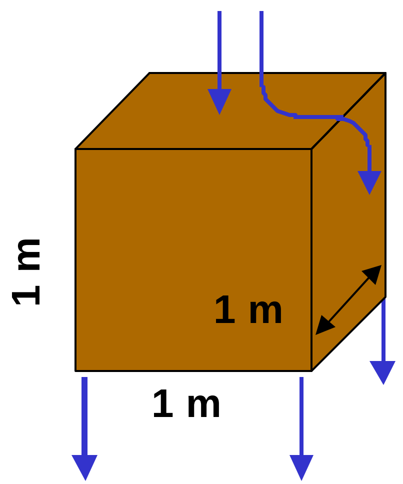
ENCAPSULATE OR IMMOBILIZE UNTIL IT NO LONGER POSES A DANGER

Leaching Assessment Protocol: General Approach

Effective Basis for EPA-DOE Agreement on Source Risk Evaluation

Alternate Leaching Procedure

Water contact mode by flow-around or percolation through



Contaminant Release to Subsurface

WASTE or SOIL
Granular, Untreated, Monolithic

Water Contact Mode

Monolithic or Low Permeability Waste

Percolation Mode
(Tier 2 - Equilibrium or Percolation-Controlled)

Information Required:
- **Availability**
- **Equilibrium Data**
- **Management Scenario**

Flow-Around Mode
(Tier 3 - Mass Transfer or Diffusion-Controlled)

Information Required:
- **Equilibrium & Availability**
- **Mass Transfer Rate Data**
- **Management Scenario**

Release and Prediction Modeling

Believable Containment

From Slide by David Kosson

Structural Integrity Risk Evaluation Under Corrosion Damage

Objective: Develop structural reliability methodology for the evaluation of DOE structures under corrosion damage

Approach:

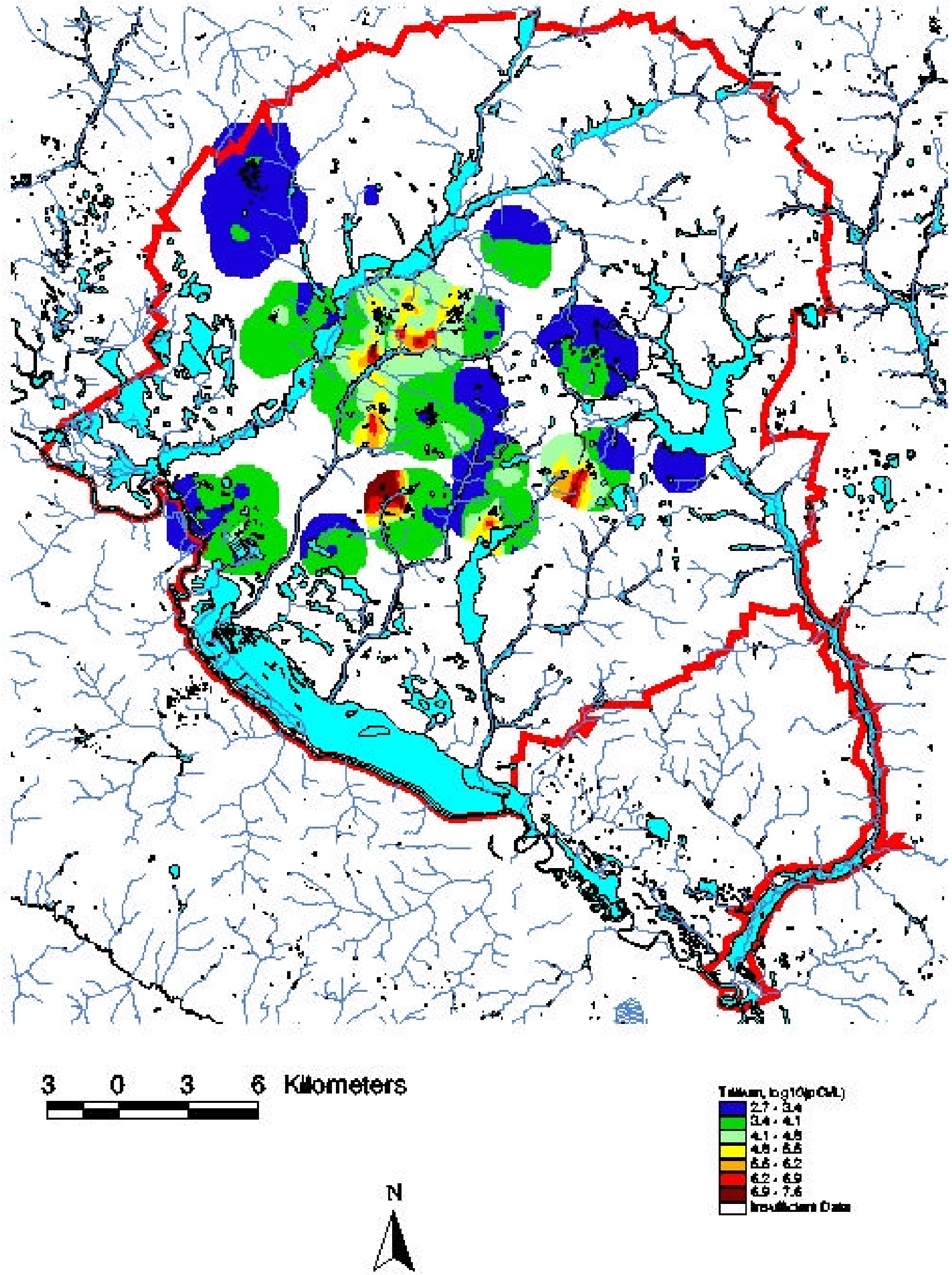
- Modeling of the corrosion damage process
- Identification of stochastic variables and their statistics
- Development of limit state-based reliability analysis methodology
- Investigate environmental, material and construction effects on structural integrity under corrosion

Expected Result:

- Probabilistic prediction of corrosion damage initiation and accumulation
- Assist in the scheduling of inspection and repair

DOE official Jerry Nelsen and CRESP Researcher, Dave Kosson, Vanderbilt

Tritium 75th
Percentile Estimates
Over the Entire
Savannah River Site



When is remediation complete?

CRESP Background Study Methodologies as a Missing Link for methodology to help frame Definition of Final Numbers for Remediation and NFA

now on the Agenda: Soils

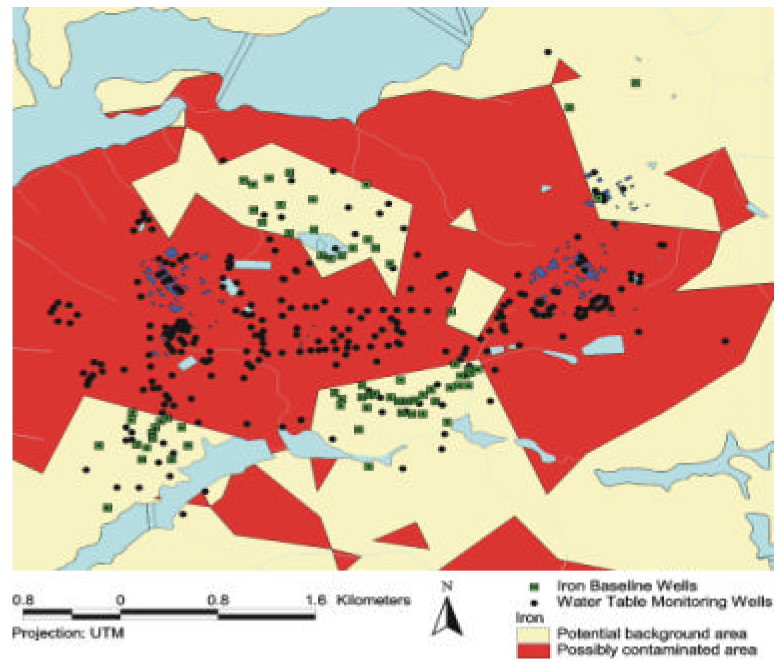
Developed by Charles W. Powers

E01: Data Management and Analysis Methods With Emphasis on Understanding Background and Trend Information

V. M. Vyas, P. Georgopoulos, S-W. Wang, M. Ouyang, A. Roy, and W. Strawderman

(In collaboration with Remediation Center)

- Implementation and evaluation of data warehousing, mining, analysis, accessing, and visualization techniques for environmental, ecological and other exposure-related information relevant to DOE-sites
- The information on background conditions is essential for accurate *Problem Definition* and for setting rational and appropriate *Goals and Objectives* as well as *Metrics for Resolution*



Iron: Potential Impacted Areas (red), Possibly Impacted Wells (black), and Background Wells (green) for the General Separations Area of SRS.

Land Disposal (Containment) Systems

Project Approach

- Review pertinent DOE LTS documents, …
- Develop a database for facilitating data accessing analysis and visualization
- Determine potential system failures and their likelihoods and consequences
- Develop event/response scenarios and logic diagrams
- Use probabilistic approach to determining impact of potential failures on risk and cost
- Use this information to improve design and post-closure responses

SURFACE AREA

COVER

SURFACE LAYER
PROTECTION LAYER
DRAINAGE LAYER
BARRIER LAYER
GAS COLLECTION LAYER
FOUNDATION LAYER

WASTE

LEACHATE RECOVERY SYSTEM

BOTTOM LINER

SUB SURFACE AREA

VADOSE ZONE

SATURATED ZONE

MONITORING

VISUAL INSPECTION

EROSION
BIO-INTRUSION
SUBSIDENCE
INFILTRATION
SEEPAGE

VADOSE ZONE

SATURATED ZONE

LEACHATE RECOVERY SYSTEM

Development and Application of Leaching Protocols for Evaluation of Leaching of Radionuclides from Soils and Sediments

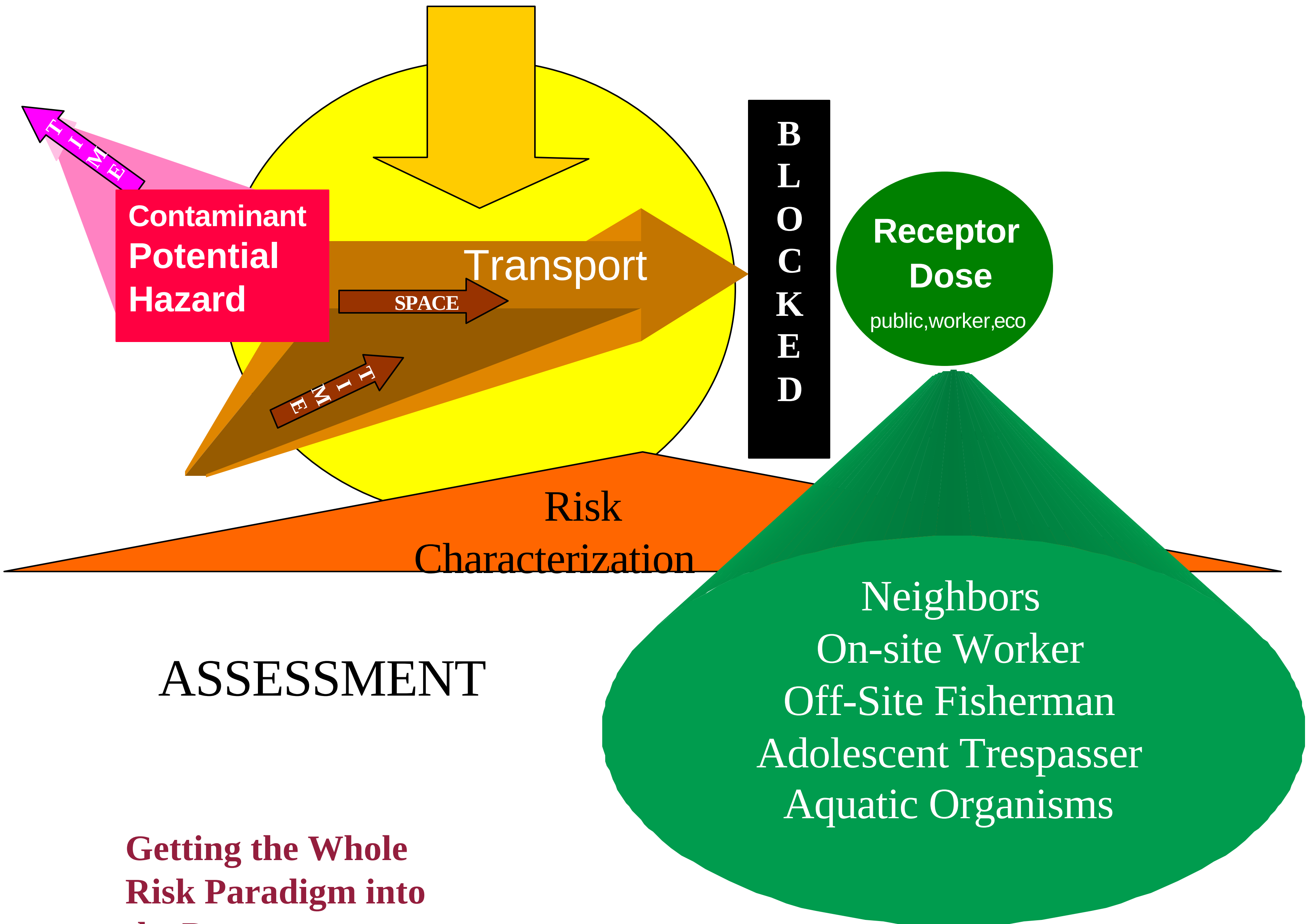
Objective: further develop and apply a new set of leaching protocols for evaluating long-term contaminant release from soils, sediments and grouted waste forms

Approach:

- Apply testing methodology to prototype soils, sediments and grouted wastes to measure intrinsic leaching characterisitics
- Expand set of long-term release models
- Development of probabilistic source terms for disposal scenarios (input to risk & performance assessments)

Expected Result:

- Improved prediction of contaminant leaching from contaminated materials management scenarios
- Criteria for treatment process evaluation & selection



ASSESSMENT

Getting the Whole Risk Paradigm into the Process

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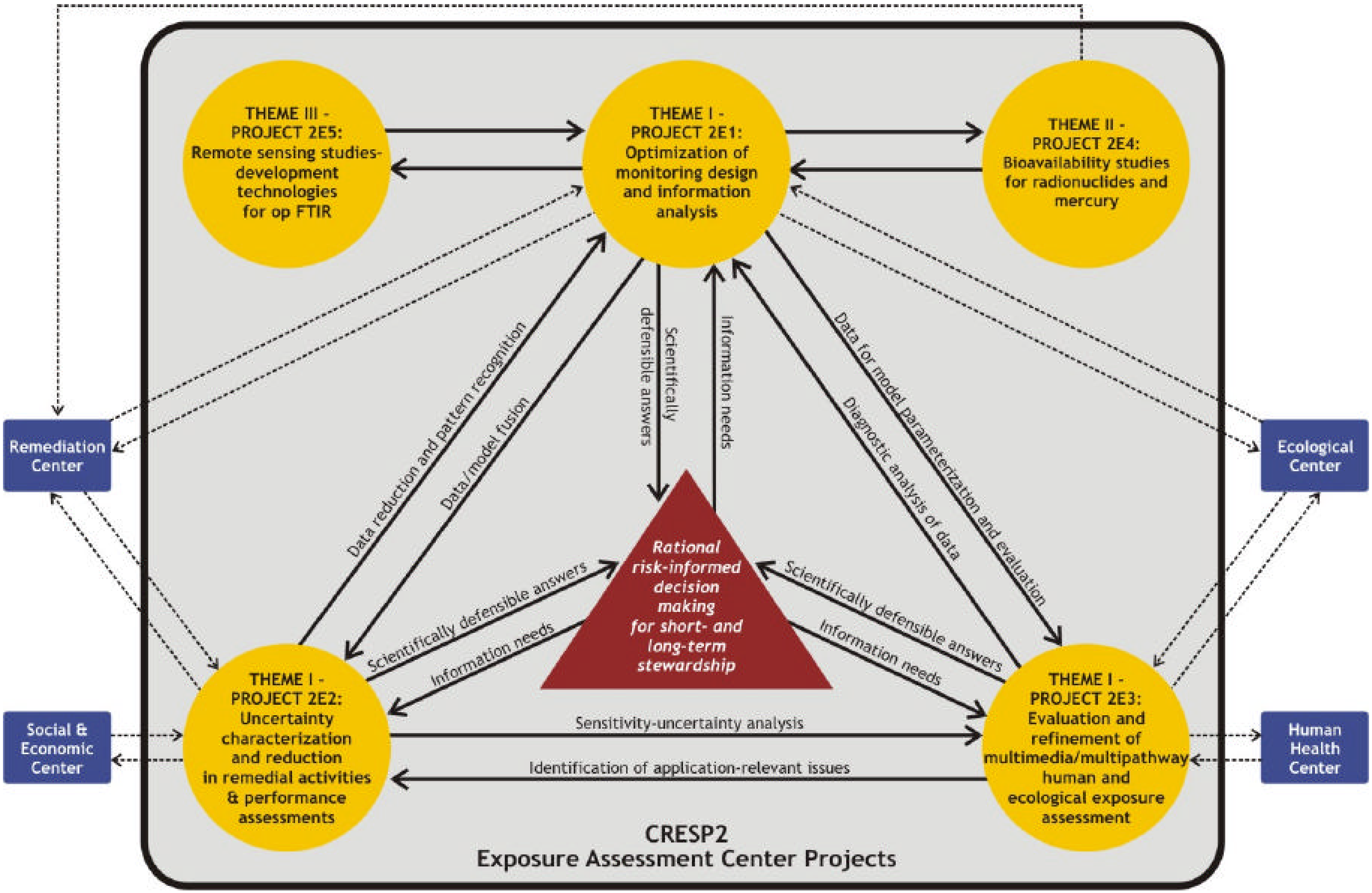
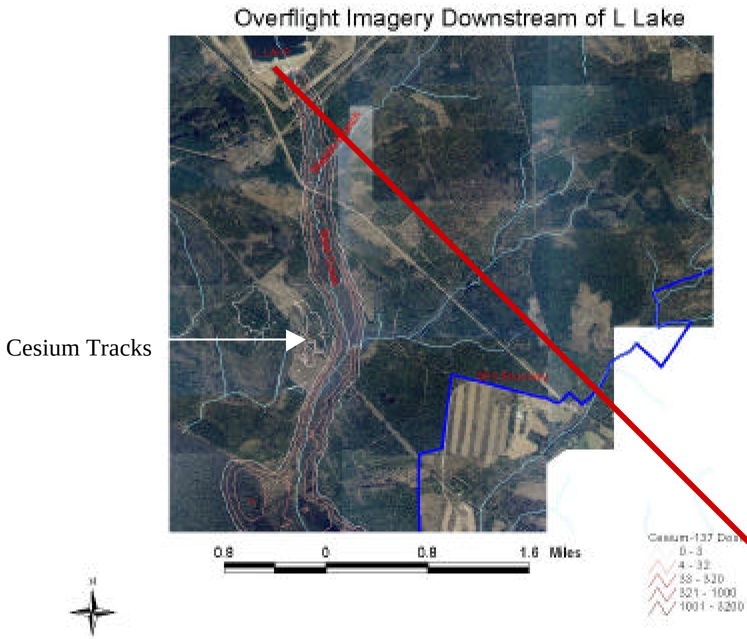
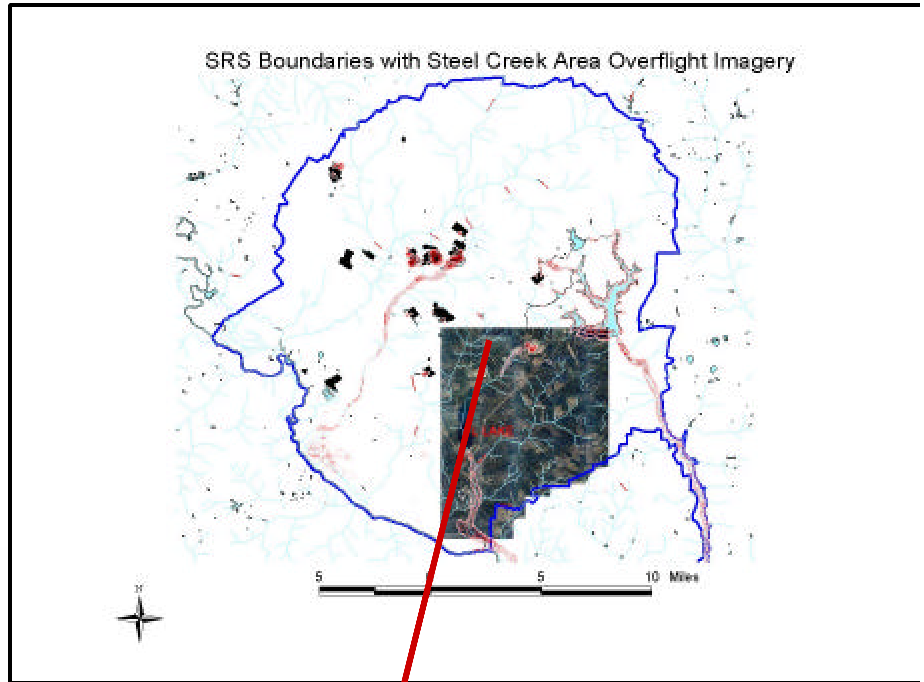
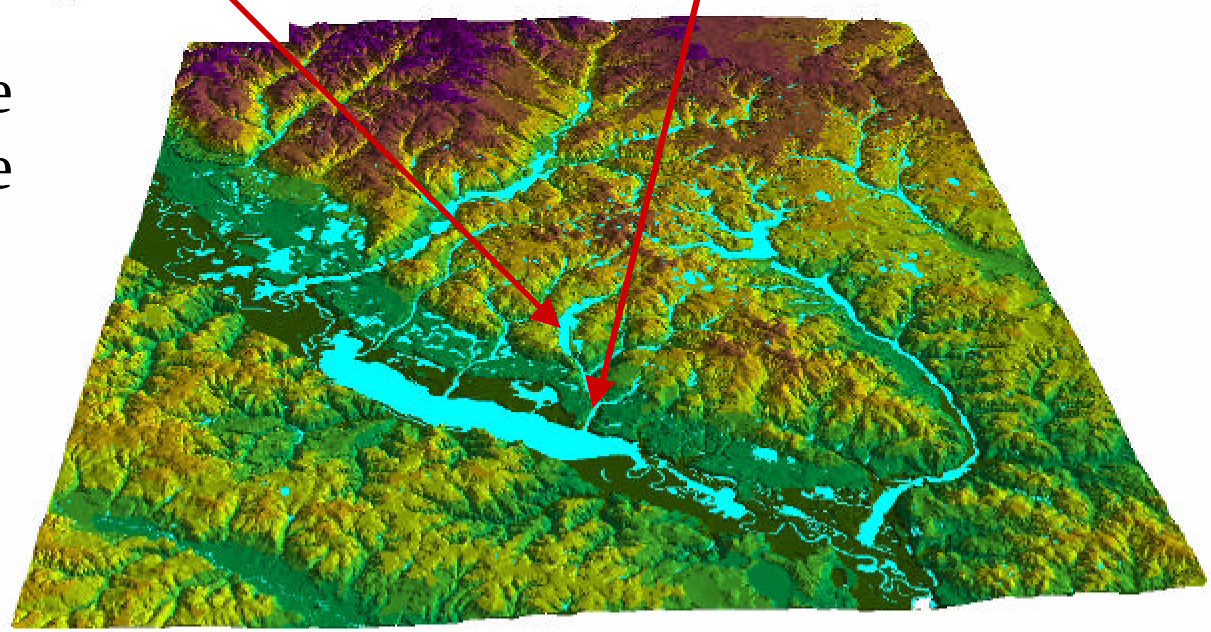
CRESP Center of Expertise in Exposure Assessment (CRESP-CEEA): Structure of Research Themes/Interactions









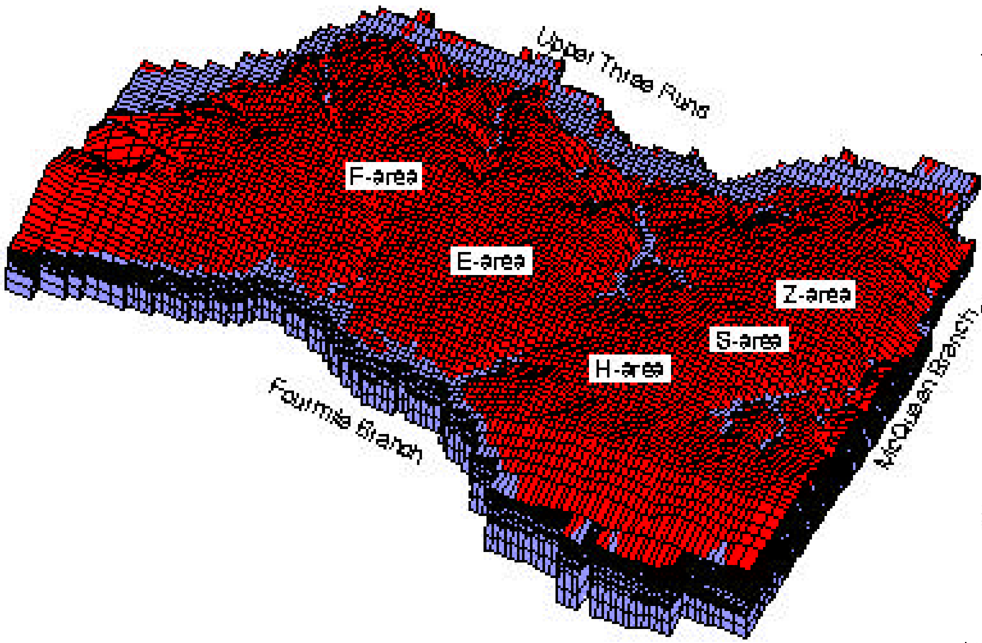
Creating the data base to transform large-site remediation: the SRS example
and telling people about it

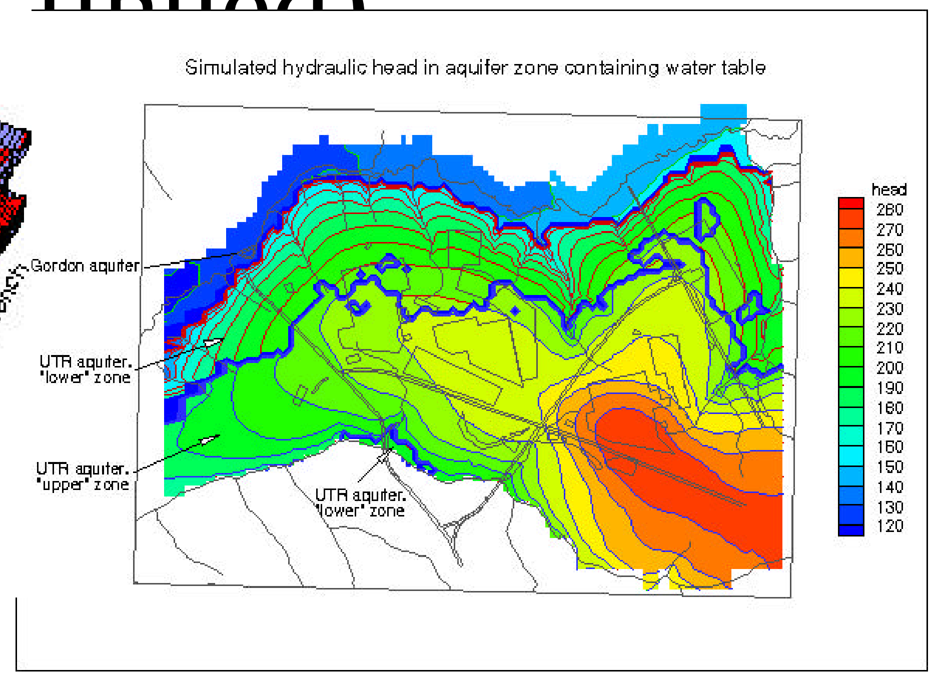
Steel Creek, SRS

Developed by Charles W. Powers

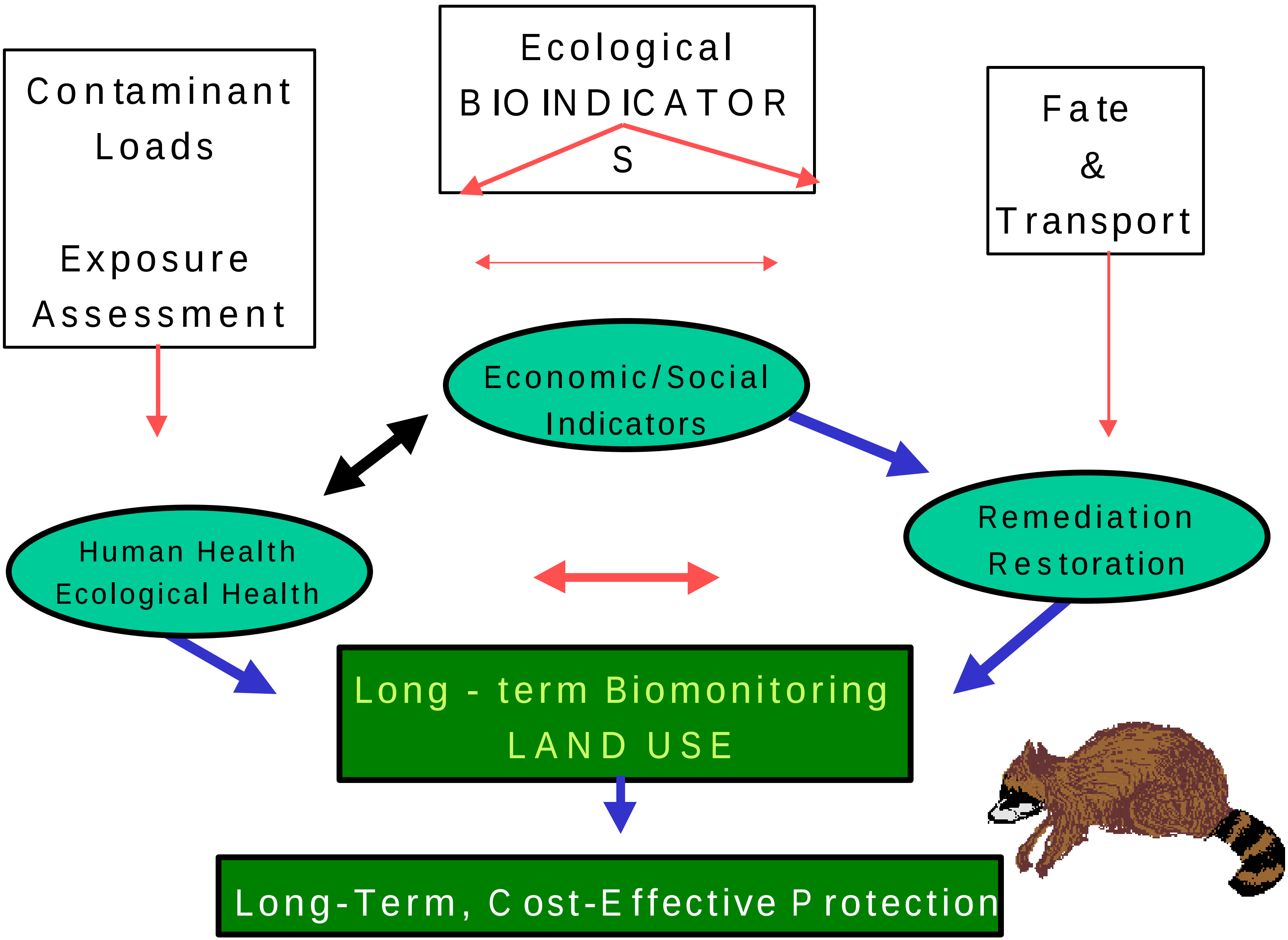
E02: Evaluation/Refinement of Multimedia Environmental Fate and Transport Modeling for DOE

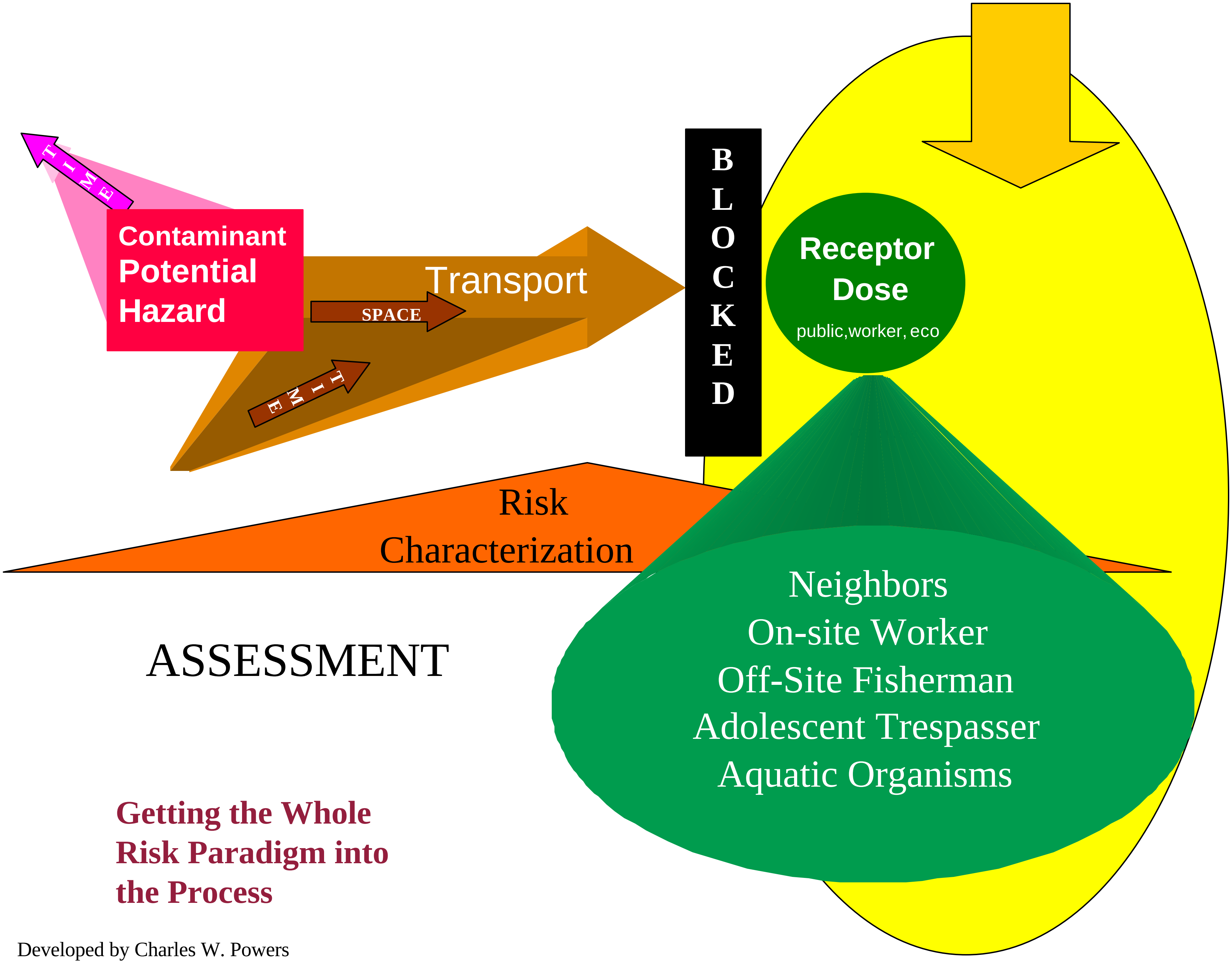
tinued)





Example: Collaborative studies with the Savannah River Technology Center employing the FACT (Flow and Contaminant Transport) groundwater flow model (a 3-d finite element model designed for SRS). CRESP-CEEA's focus is on sensitivity/uncertainty analysis and optimal parameter estimation for model calibration via model/data fusion (see following – E04).


Contaminant Loads
Exposure Assessment
Ecological BIOINDICATORS
Fate & Transport
Economic/Social Indicators
Human Health Ecological Health
Remediation Restoration
Long - term Biomonitoring LAND USE
Long-Term, Cost-Effective Protection



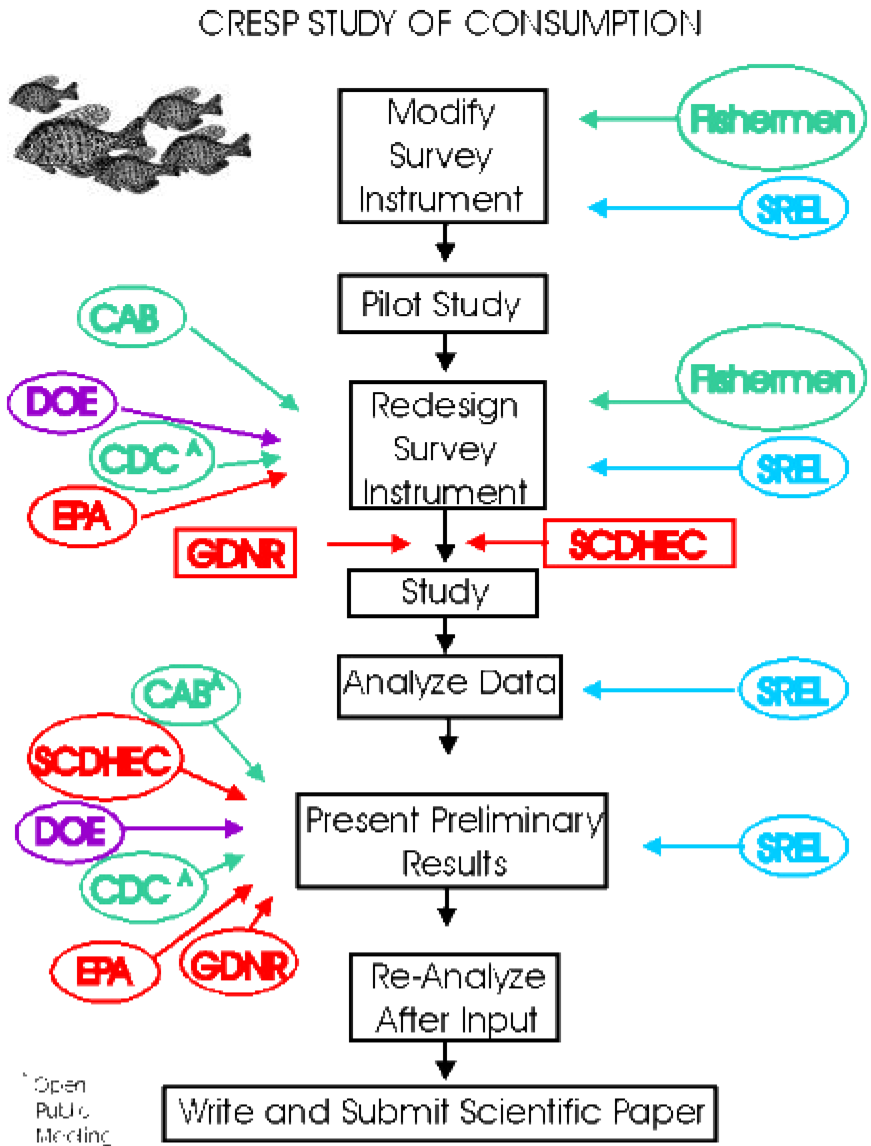
Getting the Whole Risk Paradigm into the Process

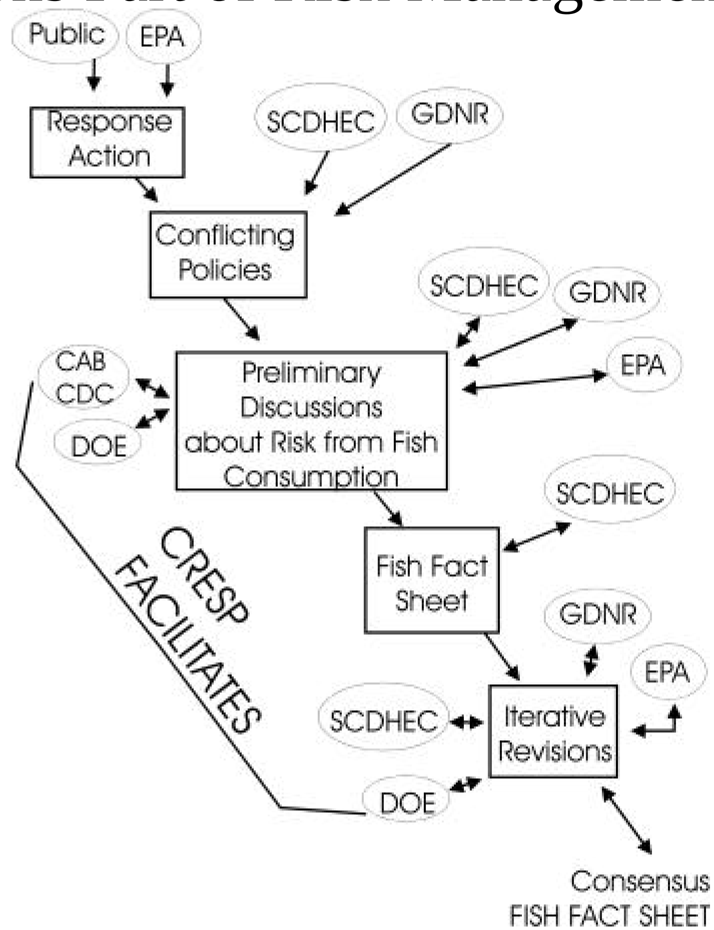
Developed by Charles W. Powers

Long–Term, Cost-Effective Protection

PUTTING PEOPLE IN THE PROCESS

Research to Help Make Risk Communications Part of Risk Management





From Conflict

to Consensus

How credible science
led to a more cost-effective
CERCLA response action

An Application of Approaches Needed at DOE Sites and Already Used Elsewhere

Developed by Charles W. Powers

The CRESP Review Committee's New Assignment

To what extent are future risks to human health at nuclear weapons sites likely to be reduced or, possibly, increased by:

a. clarification of the relevant dose-response relationships;

b. development of biomarkers for increased susceptibility;

c. development of biomarkers for early heath effects;

d. development of interventions capable of arresting incipient disease;

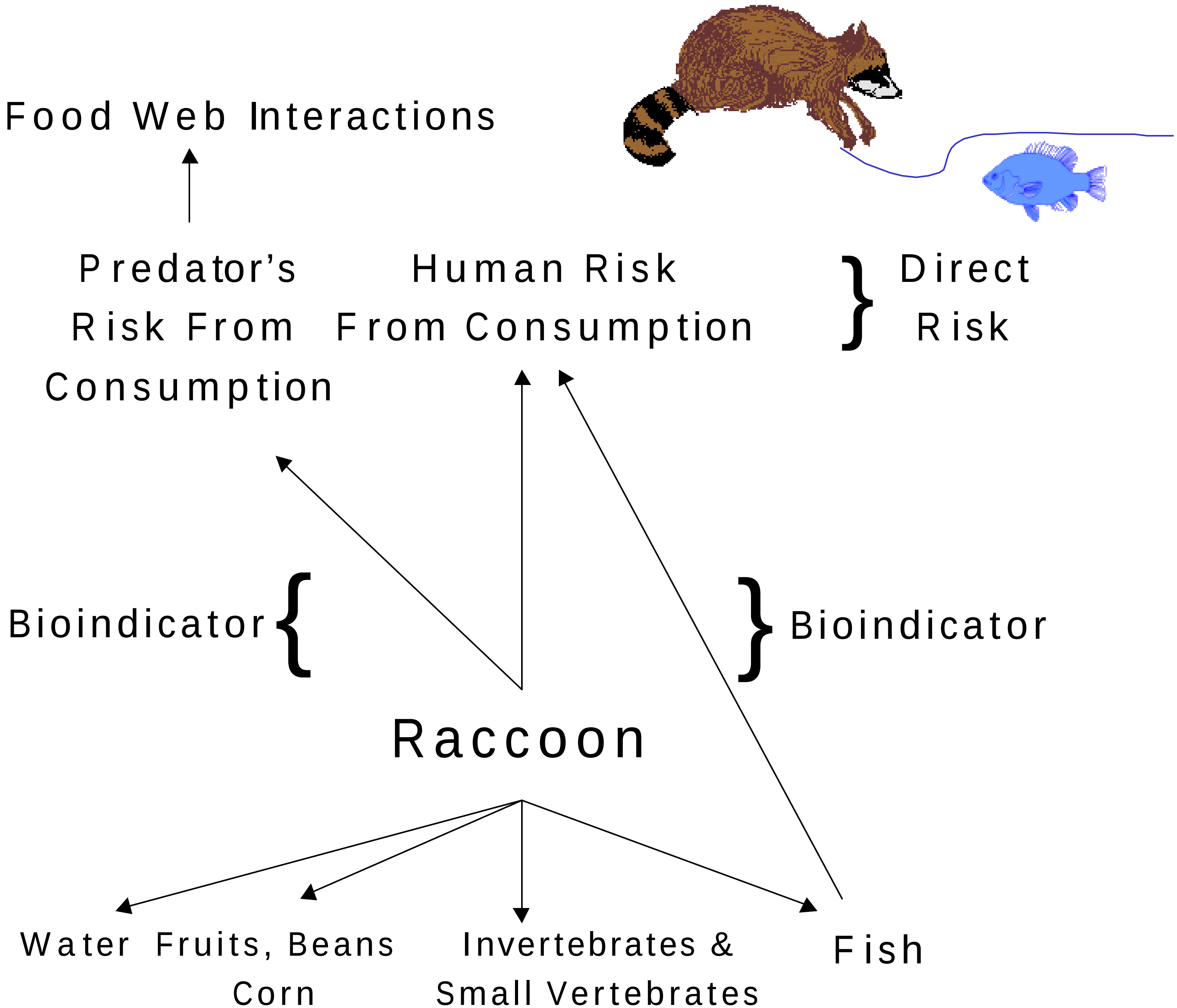
e. development of curative therapies for exposure-induced diseases?

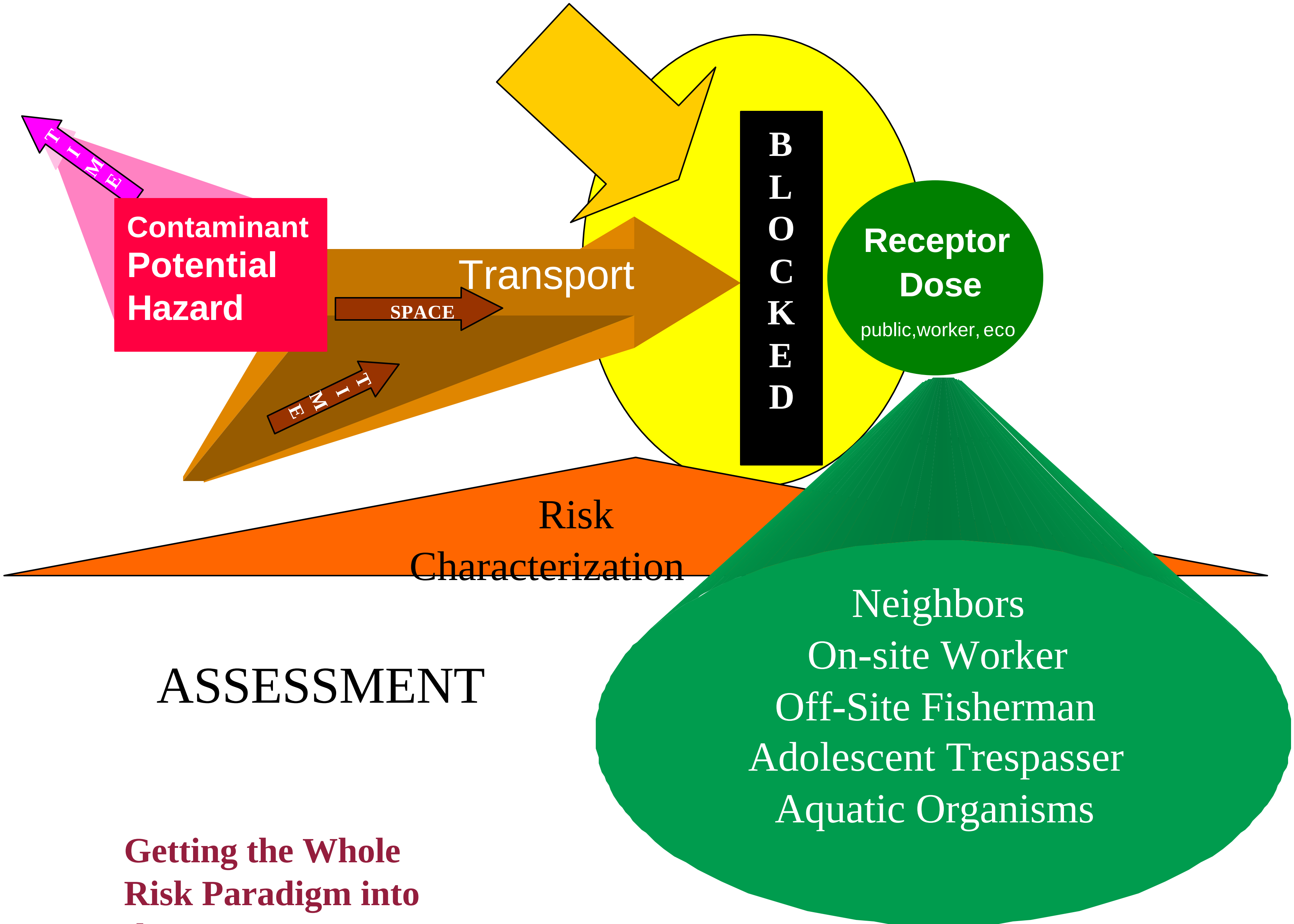
2) How will the above advances affect the relevant process of risk communication?

3) What are the related ethical issues, and how are they likely to affect the relevant methods of risk communication, informed consent, and risk management?

Beryllium Risk Density Mapping Rationale

- Beryllium recognized as concern in mid 1990s.
- Subsequent efforts to characterize beryllium exposure in Hanford buildings restricted to 25 buildings, floors walls to 8 ft.
- More extensive sampling needed to characterize interstices exposures (high risk areas for maintenance and D & D workers)
- Risk density mapping can help prioritize this ongoing characterization.


Food Web Interactions
Predator's Risk From Consumption
Human Risk From Consumption
Direct Risk
Bioindicator
Bioindicator
Raccoon
Water
Fruits, Beans Corn
Invertebrates & Small Vertebrates
Fish



Getting the Whole Risk Paradigm into the Process

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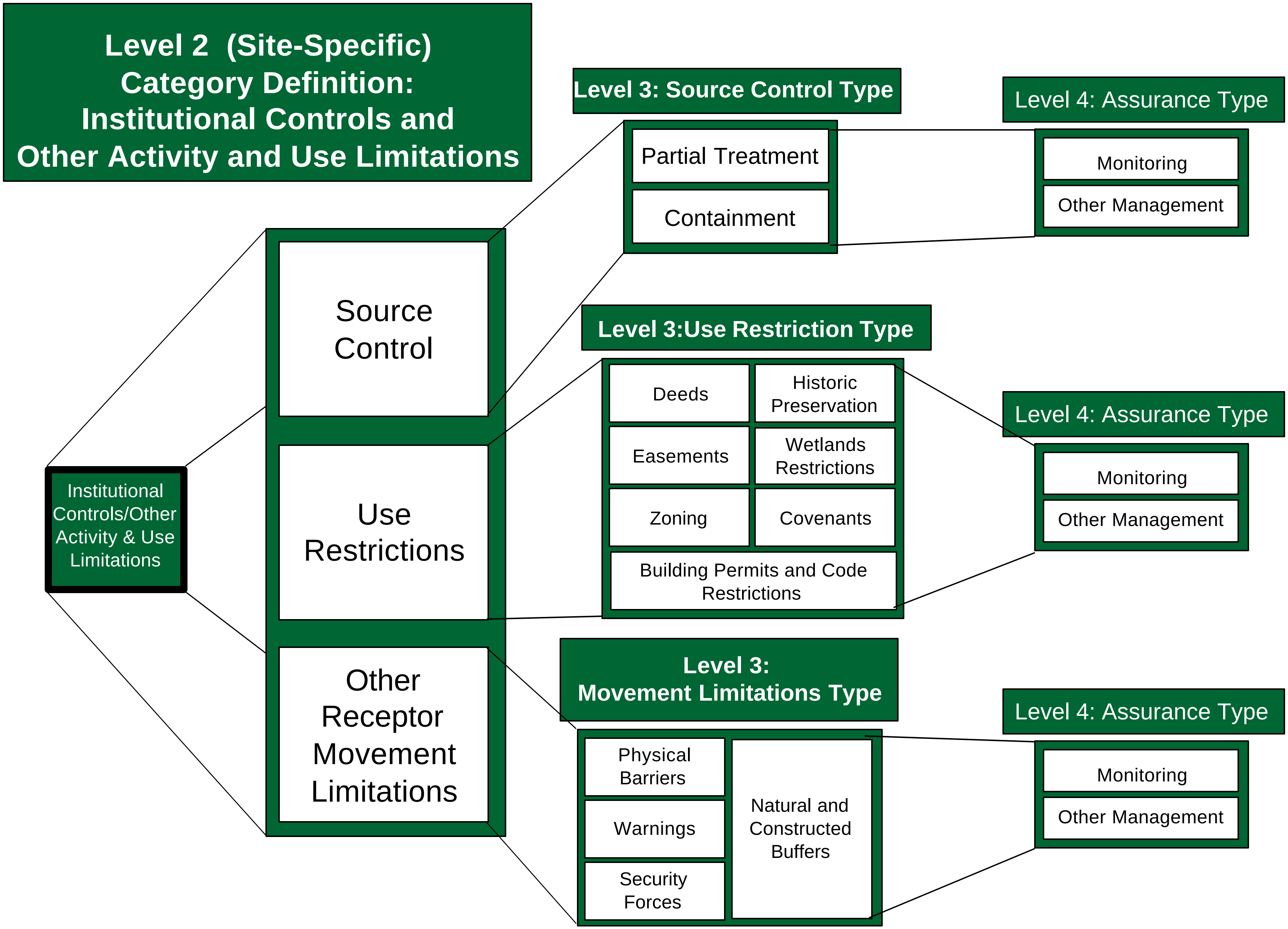
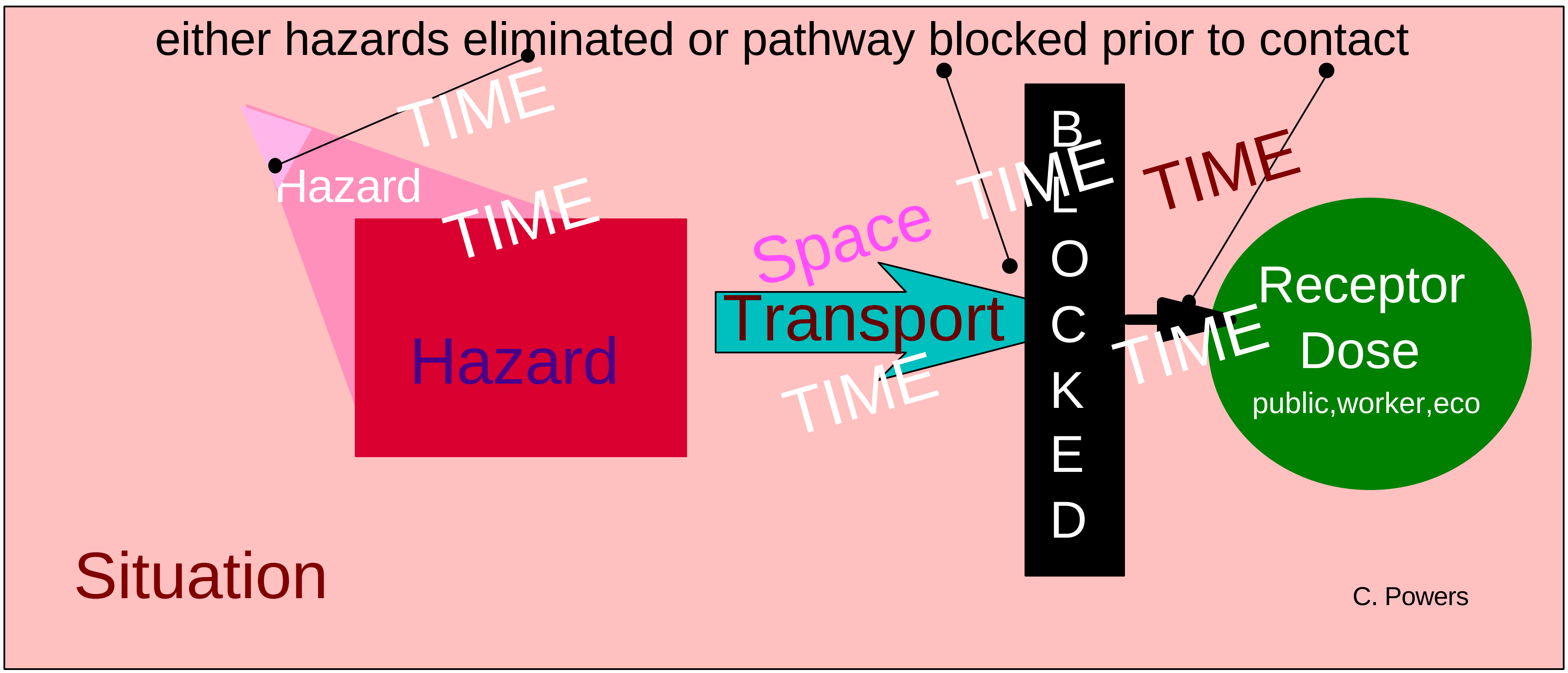


Developed by Charles W. Powers

Time and space are both the enemy and the friend of protective, cost-effective cleanup at DOE sites: because radionuclides decay over time; space is a buffer, but land use a challenge



WHEN?

Timelines:

PA’s and CA’s

1,000

5 5 5 5 30 100

CERCLA and RCRA and some State Waste Laws

Changes in the Way Regulations
Relate or are Implemented Together

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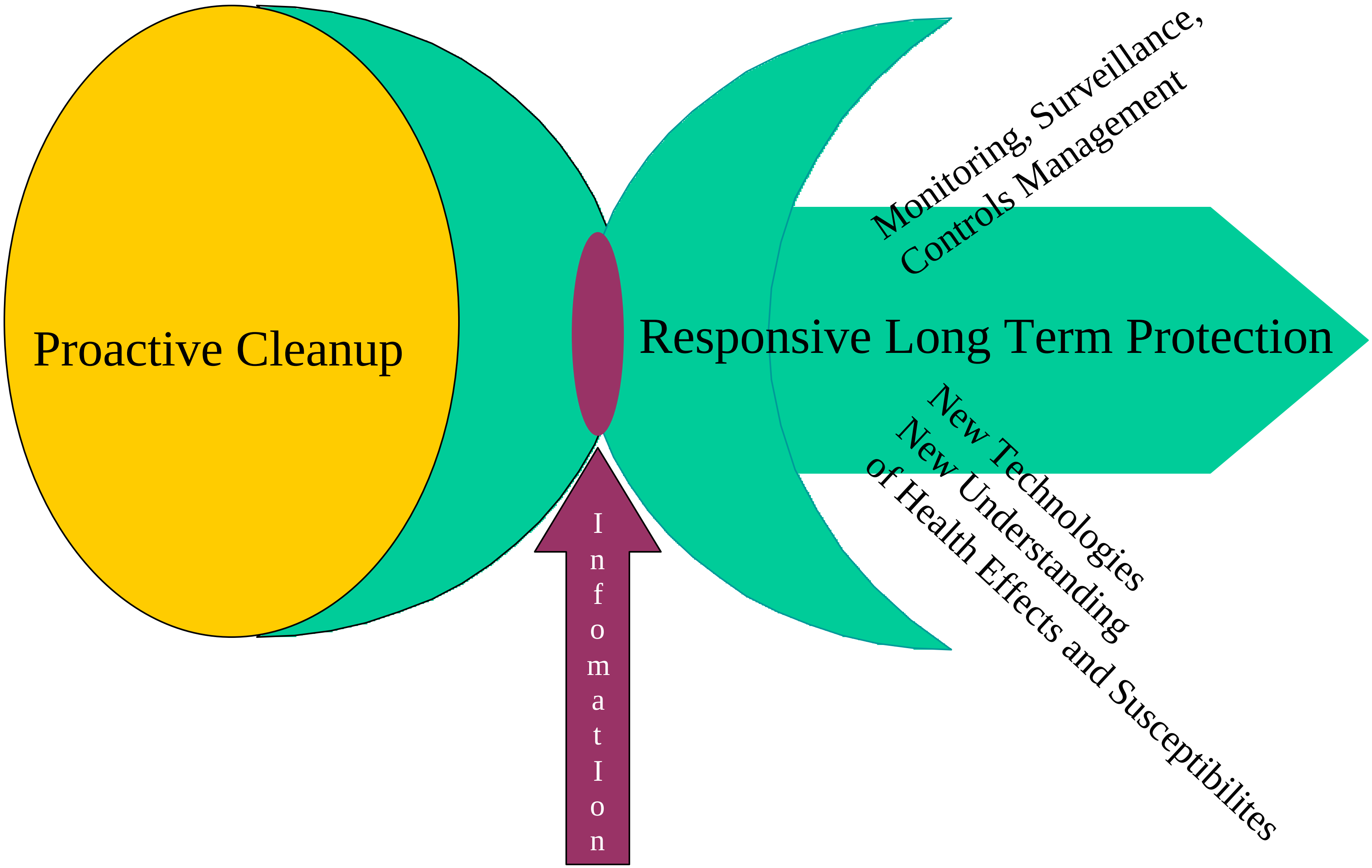

Proactive Cleanup
Responsive Long Term Protection
Monitoring, Surveillance,
Controls Management
New Technologies
New Understanding
of Health Effects and Susceptibilites
I n f o m a t I o n

How should we select institutional controls and monitor their performance?

ERDF

Columbia River
circa 1950s

Using the concept of vulnerability in remedy selection

BC Area - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites History

Address http://www.yetiarts.com/dms/areas/100/reactor_areas/bc.html Go Links

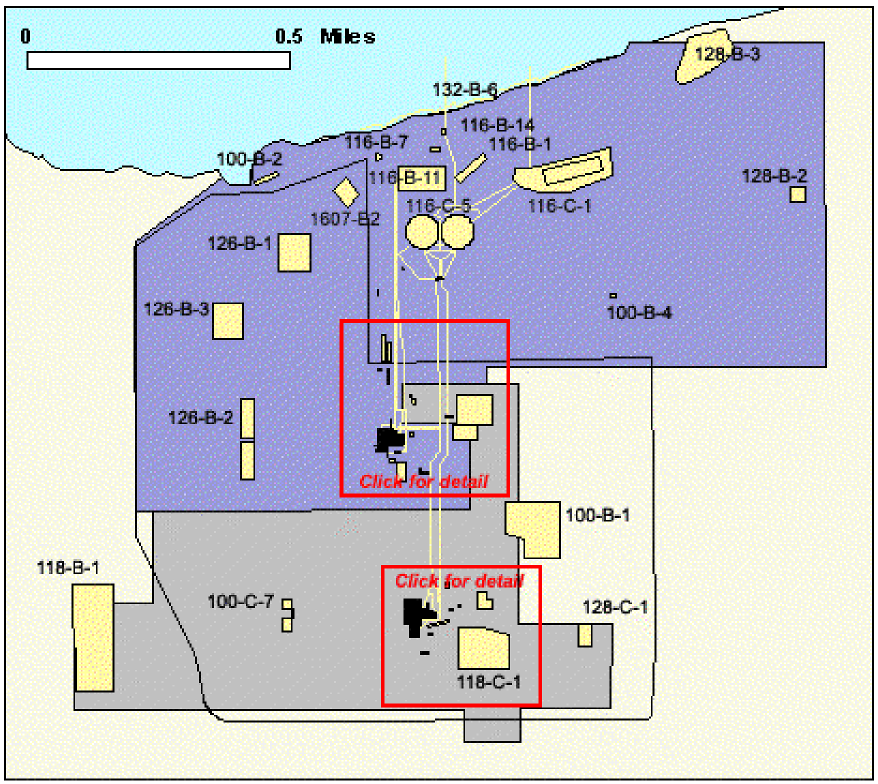
DMS
DECISION MAPPING SYSTEM

BC Area

DMS Project > Decision Mapping System > Hanford DMS > 100 Area > 100 BC Area

The 100 BC Area contains two retired nuclear production reactors. The B Reactor operated from 1944 through 1968, and the C Reactor operated from 1952 until 1969.

Contents: [Operable Units | Decisions | Waste Sites | Progress | Metadata | Library]



Reactor Area
Level Sidebar

Links:

BC Area Map
BC Area Overview
Decisions
Progress
Geographic
Library
Discussions

DMS Project

- Introduction
- Transparency
- Decision Mapping System
  - DMS Templates
  - Hanford DMS
- Project History
- Methodology

http://www.yetiarts.com/dms/areas/100/reactor_areas/bc_content.html Internet

The Decision Mapping System Introduction - Microsoft Internet Explorer

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Introduction

DMS
DECISION MAPPING SYSTEM

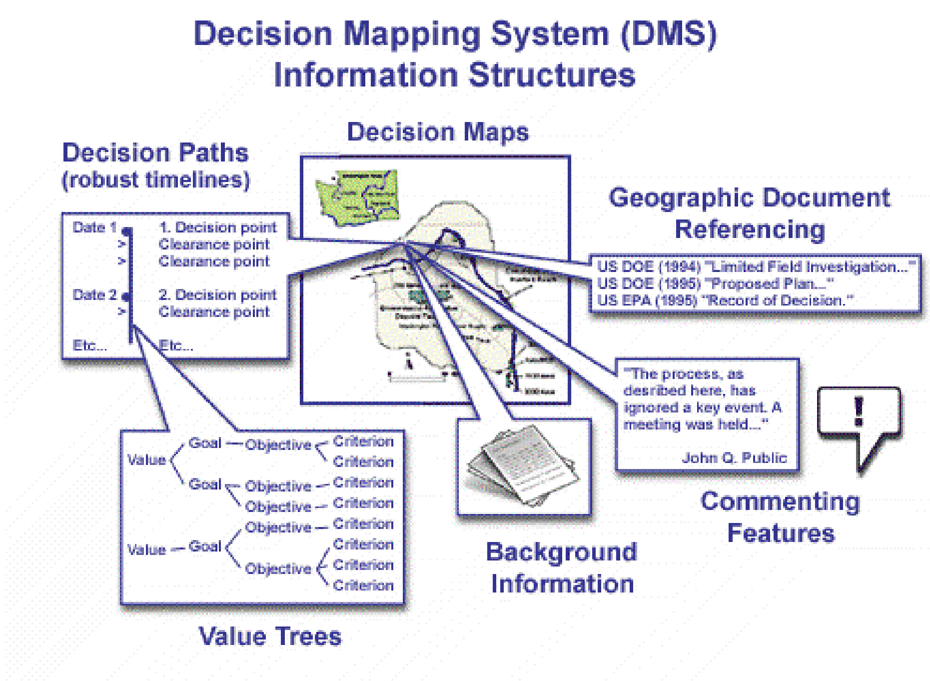
DMS Project

- Introduction
- Transparency
- Decision Mapping System
  - DMS Templates
  - Hanford DMS
- Project History
- Methodology

How does it work?

The DMS combines six independent information structures in a series of web pages. These structures can be thought of as templates for organizing important spatial, temporal and socio-cultural information about a decision. Click here to see more about the templates.

Note: For this demonstration project, the DMS has been developed for one decision at Hanford - the 100 Area Soil Cleanup decision.



Click a structure to get more detail

(Image map instructions; Information structures templates page; each graphic/words individual page for that structure. Pls insert a new graphic for the

http://www.yetiarts.com/dms/intro_frame.html Internet

116-C-1 Waste-site Information

Developed by CRESP Researcher, Christina Drew

- Name: 116-C-1 Process Effluent Trench
- Location: 100-BC Area (GIS coordinates)
- Type: Process Effluent Trench learn more
- Status: Complete (see CVP 98-0006)
- Excavation Diagram
- Dimensions:
  - Site Depth Designation: Intermediate
  - Rectangular: 167 m x 32 m x 5.2 m (548 ft x 105 ft x 17 ft)
  - Volume: 31,957 CM (41,799 LCY)
- Contaminants of concern:
  - Radionuclides: ^{137}CS, ^{152}EU, $^{239/240}$PU, ^{241}AM, ^{60}CO, ^{154}EU, ^{155}Eu, ^{238}Pu, ^{90}Sr, ^{238}U,
  - Inorganics: Cr(total), Cr^{+6} (Hex), Hg, Pg, Sb
- Cost
- Risk estimates

- Decision Information
  - 100 Area Soil cleanup ROD
  - TPA Milestones
- Related (Analogous) sites list
- Make a comment
- Sources

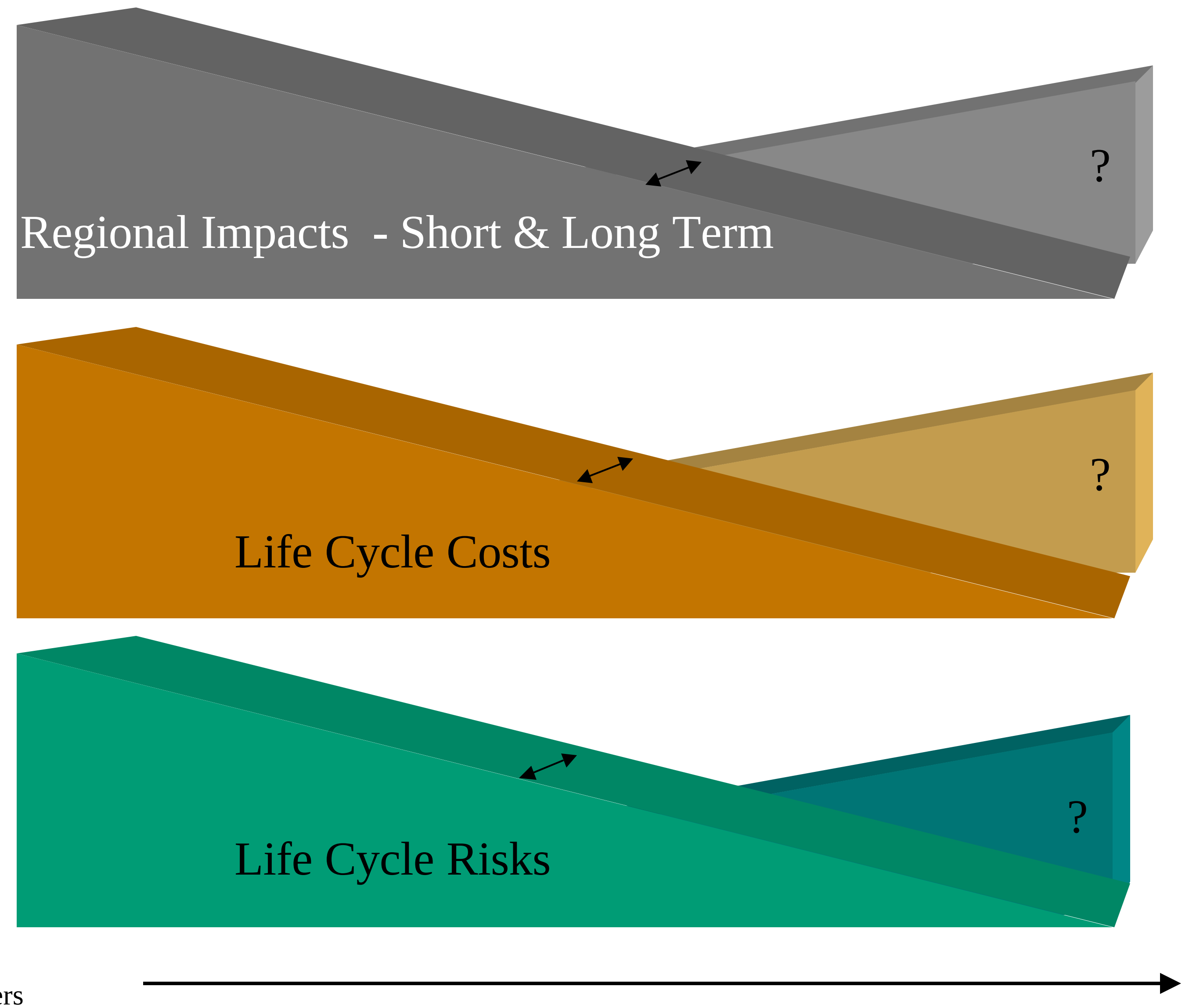
Sources: DOE, 1999. Cleanup Verification Package (CVP-98-0006) and DOE 1998, Remedial Design Report/Remedial Action Work Plan for the 100 Area. (DOE RL-96-17)

Dimension 2: Institutional design

- **Single institutional approach:**
The institutional control and measures of this type rely on one institution, probably the DOE, such as fences and on-site enforcement.

- **Multi-institutional approach:**
consciously employs more than one institution in institutional control and monitoring measure design

Developing the Metrics for Forecasting LTS - an Interdisciplinary Challenge

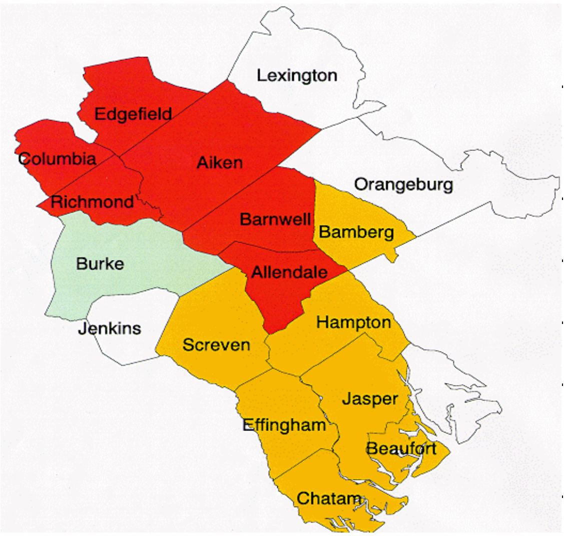


Developed by Charles W. Powers

Sampling Frame

What does the public really think?

- Size: N=1,671 randomly selected respondents; pilot N=267 respondents (142 randomly selected)
- Geographic Parameters: 14 counties; within approximately 86 mile radius of SRS
- Stratification: by economic dependence on site
- Sampling Error: *Total Population*= $\pm$ 2% Margin of Error; *Up/Down River*= $\pm$ 3% and $\pm$ 4% Margin of Error Respectively



- to identify determinants of perception of risk and neighborhood quality among SRS residents;
- to examine the relationship between risk perception and various potential hazardous waste management and remediation activities at the SRS;

Conclusions

– *Low resident risk perception* is closely associated with the following stakeholder characteristics:

– a willingness to accept hazardous waste into their community;

– a willingness to accept some health risks for economic gain;

– being “up-river” from SRS;

– living in a community that is economically dependent on SRS *OR* being employed at the site;

– having trust in SRS related institutions and individuals;

– living in a highly populated county.

– *Heightened resident risk perception* is closely associated with the following stakeholder characteristics:

– a reluctance to accept hazardous waste or health risks for economic gain;

– having a low family income;

– being poorly educated;

– living “down-river from SRS;

– living in a community that is not economically dependent on SRS *OR* being employed at place other than SRS;

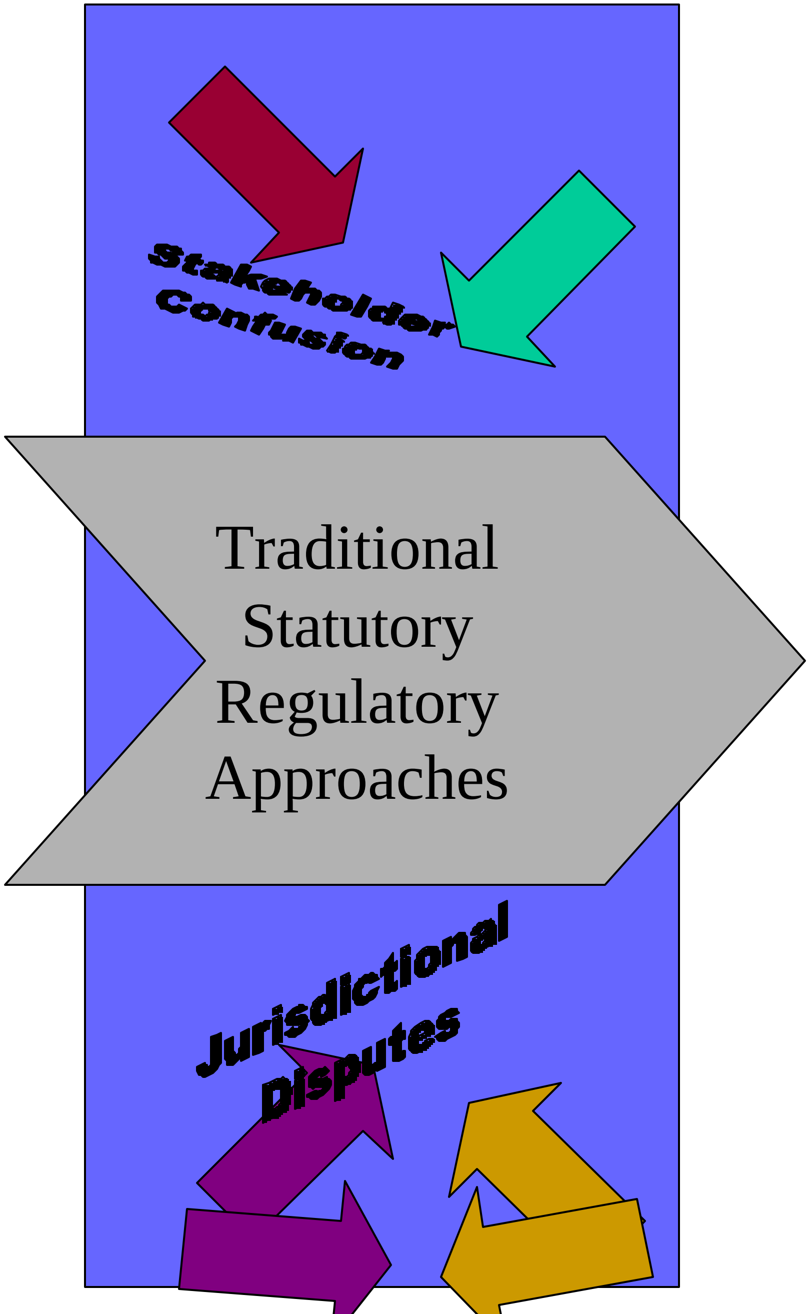
ECONOMIC ANALYSES & STEWARDSHIP

1. 26-region REMI model configured around DOE regions, including INEEL, Savannah River, Oak Ridge, Hanford, and others. Ability to study meso and macro scale economic cost and regional economic benefits

2. MESO: Salt waste issue in HLW tanks at SRS.
   - 2.1 Review of four technologies: grout, caustic, ion exchange, and small tank
   - 2.2 Location where design, testing will occur
   - 2.3 Payment options: new taxes, DOE budget, DOE EM budget, and SRS budget.
   - 2.4 Payment options and location where design will take more place to more important to regional economic impact than choice of technology

3. MACRO: Analysis of Regional Economic Impacts of DOE Environmental Management Budgets

- 3.1 <u>Recent past policy</u>: Flat line budget and same amount goes to each site each year
- 3.2 <u>Speed up:</u> *Paths to Closure* which has closure sites (Ohio, Rocky Flats, others) and sites that will require major expenditures (SRS, Hanford, INEEL)
- 3.3 Budget reductions: Economic/political decisions requires substantial cuts in site-region budgets
- 3.4 Enormous regional economic impacts at Hanford, SRS, and INEEL, and to a lesser extent the other site-regions



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Specific Changes in the Regulations Themselves Needed Especially at DOE

Changes in the Way Regulations Relate or are Implemented Together

Problem-Responsive, Integrated Regulatory Compliance

Application of Approaches Needed at DOE Sites and Already Used Elsewhere

Regulations Fashioned for the Unique Problems of DOE Sites

Changes Needed:	Practice	Policy	Regulation	Statute
Specific Changes in the Regulations Themselves Needed Especially at DOE	Decision Maps	TCLP		New Waste Definitons Classifications
Changes in the Way Regulations Relate to or are Implemented Together			CERCLA-PA-CA	
Application of Approaches Needed at DOE Sites and Already Used Elsewhere	Fish Fact SRS	Restoration Eco for Ecological Risk		
Regulations Fashioned for the Unique Problems of DOE Sites	IOU		IOU	IOU

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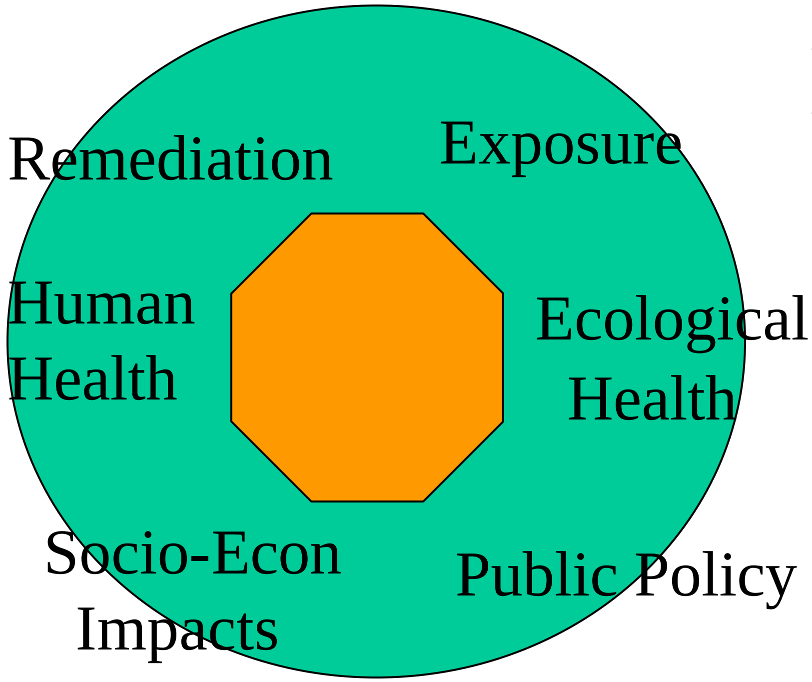
A New Approach to Consortium Management

A Management Board Largely Made Up of Leaders of Centers of Excellence

David Kosson
Vanderbilt

Elaine Faustman
UW

Michael Greenberg
Rutgers



Paul Lioy/
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Arthur Upton

Barry Friedlander- IRM/UMDNJ

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